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(12) **United States Patent**
Hahn et al.

(10) **Patent No.: US 9,215,880 B2**
(45) **Date of Patent: Dec. 22, 2015**

(54) **COMBINATION AUTOMATED AND HAND DEBONING APPARATUS AND METHOD WITH SINGLE UNIT PROCESSING**

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(73) Assignee: **Baader Linco, Inc.**, Kansas City, KS (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 272 days.

(21) Appl. No.: **13/856,281**

(22) Filed: **Apr. 3, 2013**

(65) **Prior Publication Data**

US 2013/0280998 A1 Oct. 24, 2013

Related U.S. Application Data

(60) Provisional application No. 61/637,102, filed on Apr. 23, 2012.

(51) **Int. Cl.**
A22C 17/00 (2006.01)
A22C 21/00 (2006.01)

(52) **U.S. Cl.**
CPC ***A22C 21/0069*** (2013.01); ***A22C 21/003*** (2013.01)

(58) **Field of Classification Search**
USPC 452/135–137, 149–153, 155, 156, 198
See application file for complete search history.

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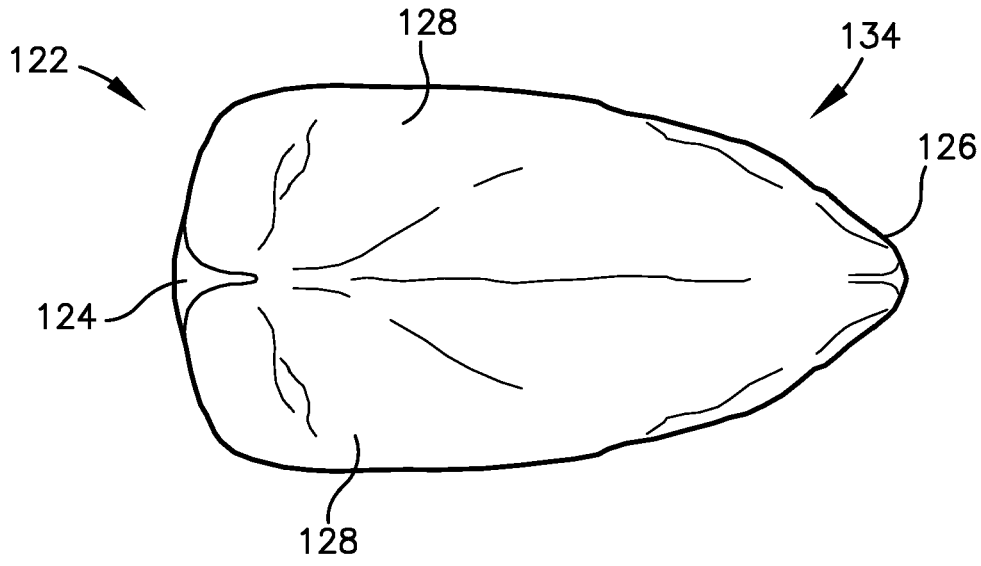
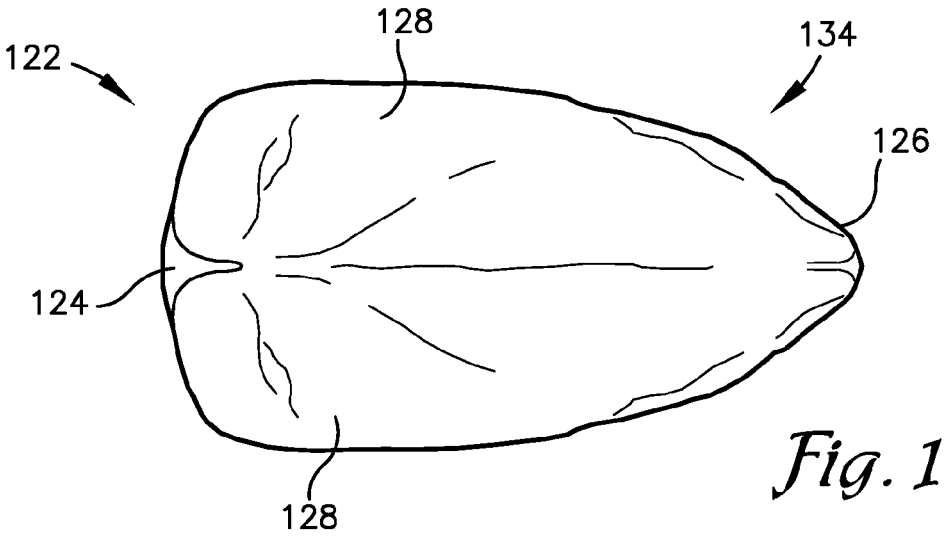
Primary Examiner — Richard Price, Jr.
(74) *Attorney, Agent, or Firm* — Spencer Fane Britt & Browne LLP

(57) **ABSTRACT**

An apparatus and method for separating wanted tissues from a bird carcass comprises mechanical and manual manipulation of the tissues. Mechanical manipulation includes scoring the lateral side of the carcass below the ribs between the neck opening and vent to separate the breast tissue from the skeletal system, and cutting the breast tissue and tenderloin tissue from the breast bone. Manual manipulation of the wanted tissues includes: mounting the carcass on a fixture, grasping the breast tissue adjacent the neck opening, and moving the hand toward the vent to separate the breast tissue from the carcass; and grasping the tenderloin tissue adjacent the neck opening, and moving the hand toward the vent to separate the tenderloin tissue from the carcass. Alternatively, the breast tissue may be harvested as a butterfly filet by scoring the lateral side of the carcass and removing the breast tissue from the carcass.

13 Claims, 20 Drawing Sheets





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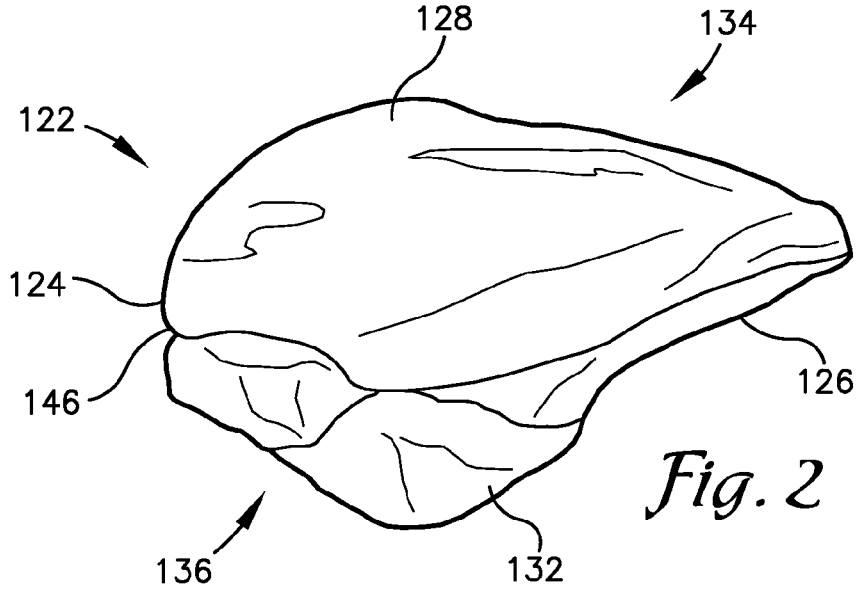

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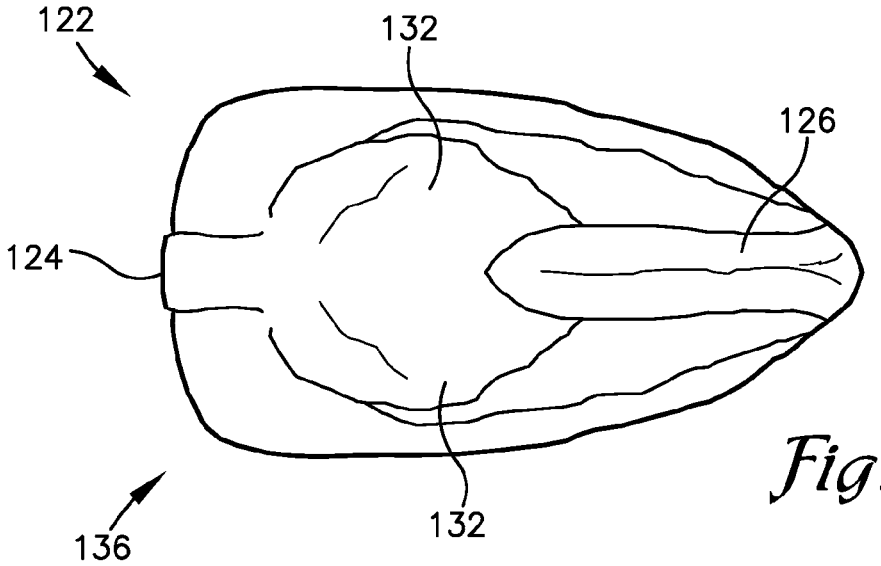

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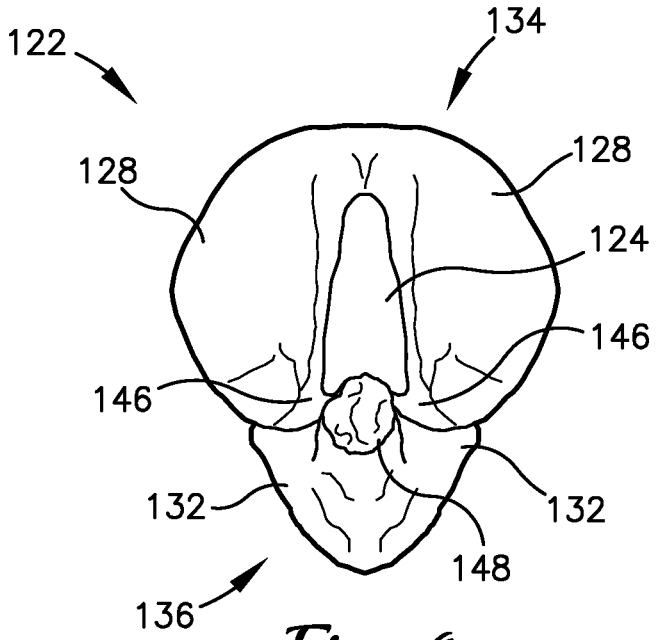
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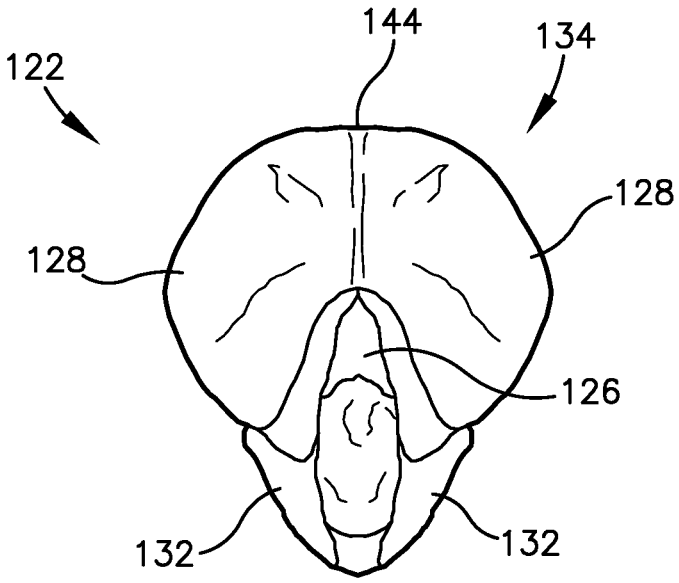
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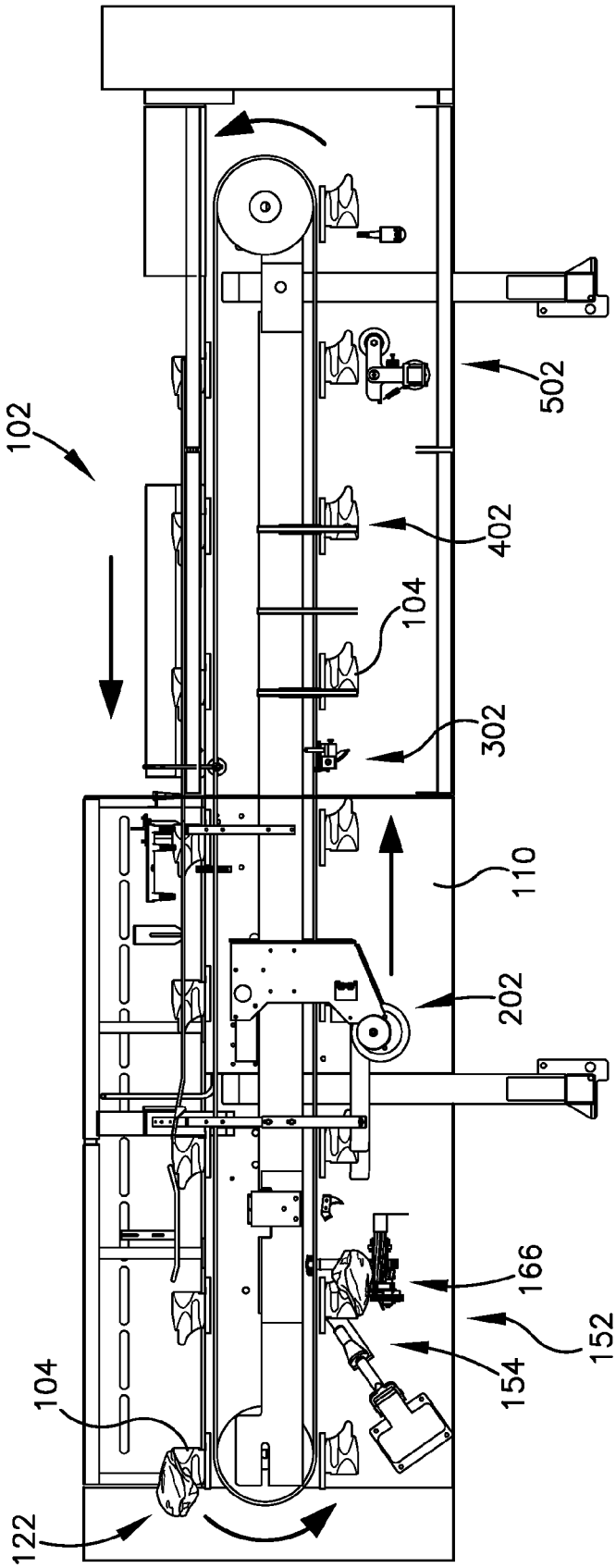

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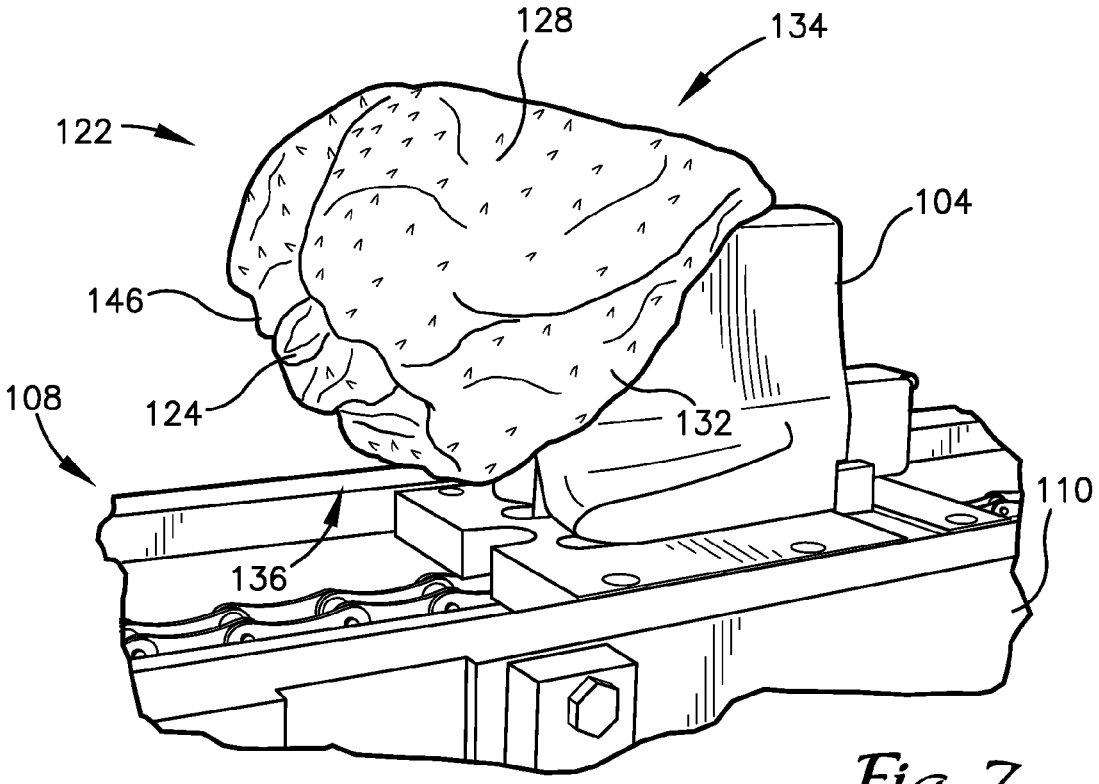
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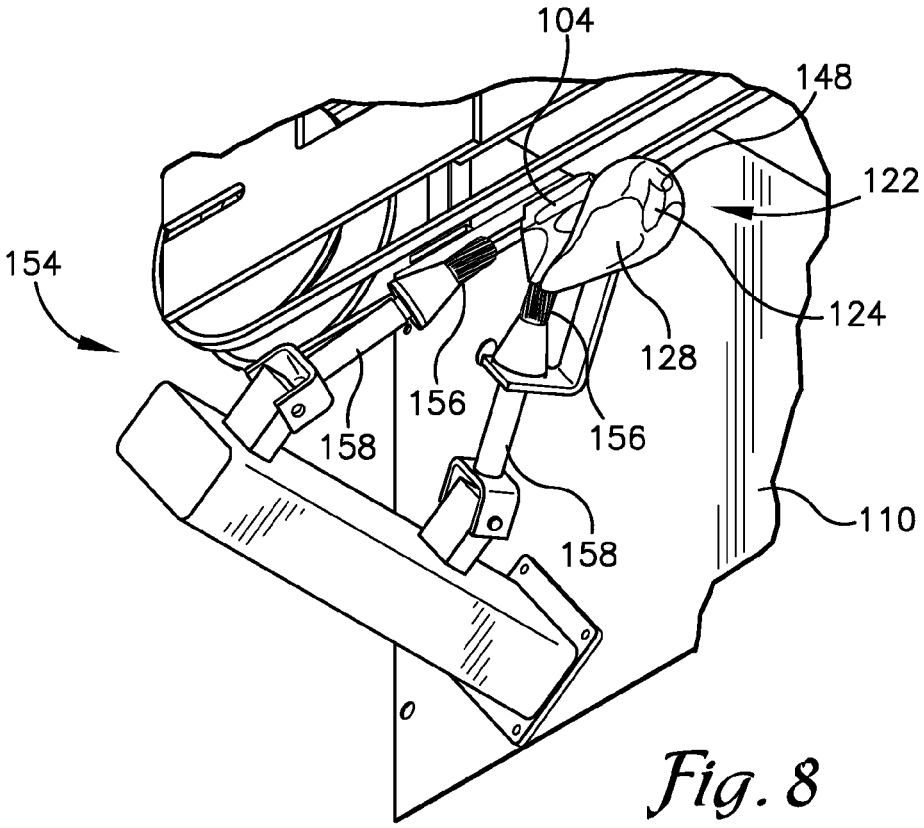
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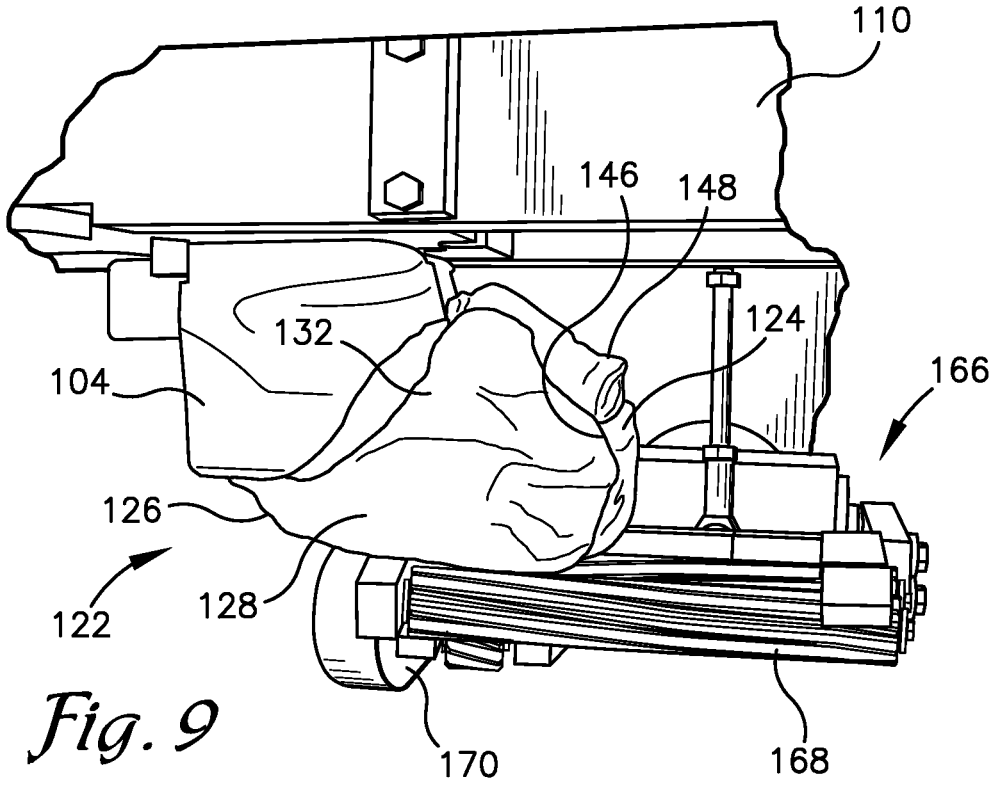
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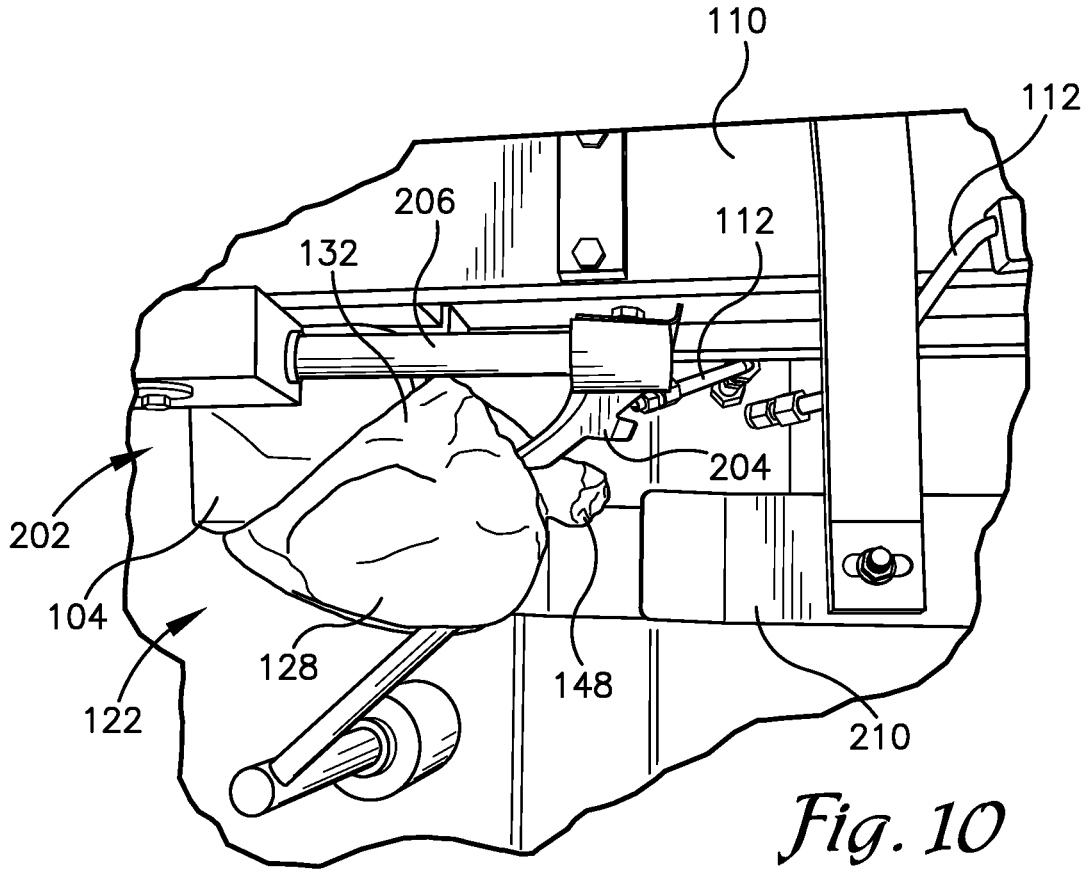
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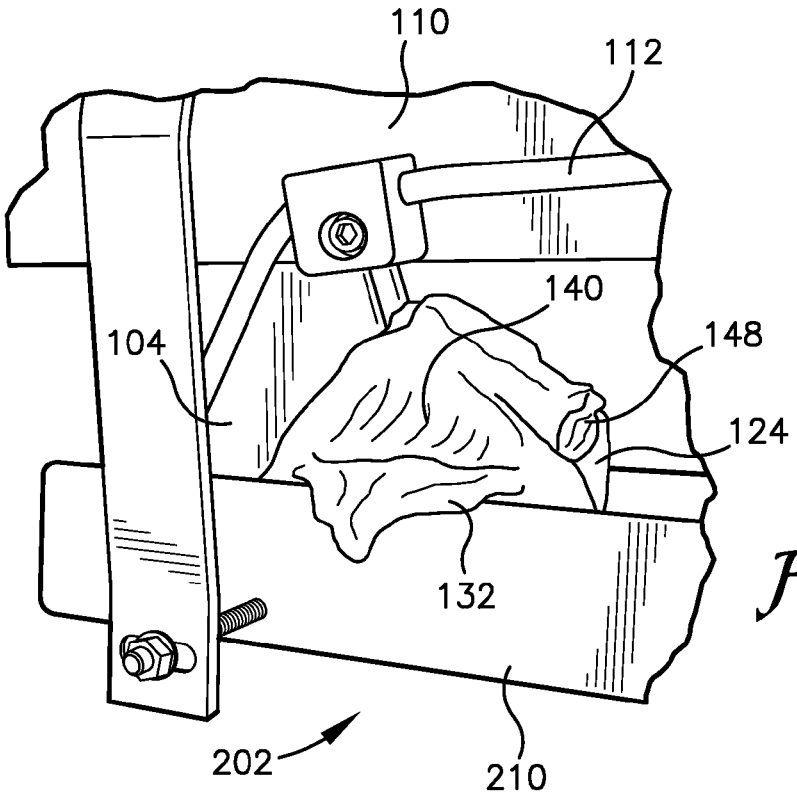

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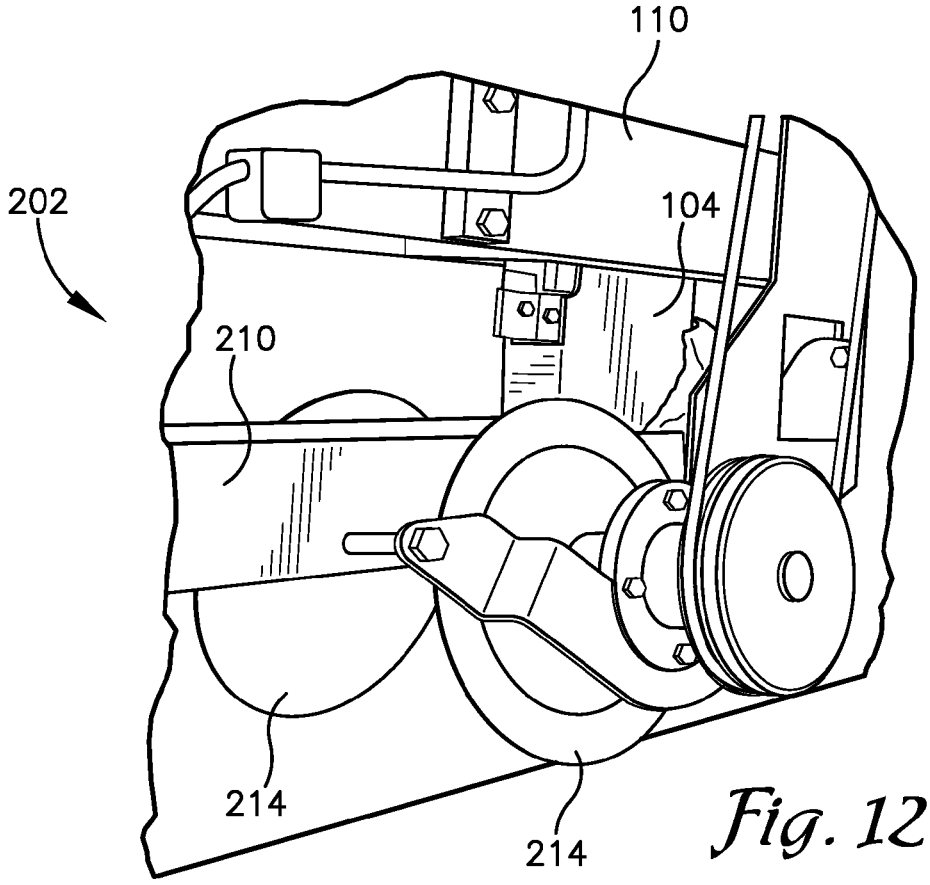

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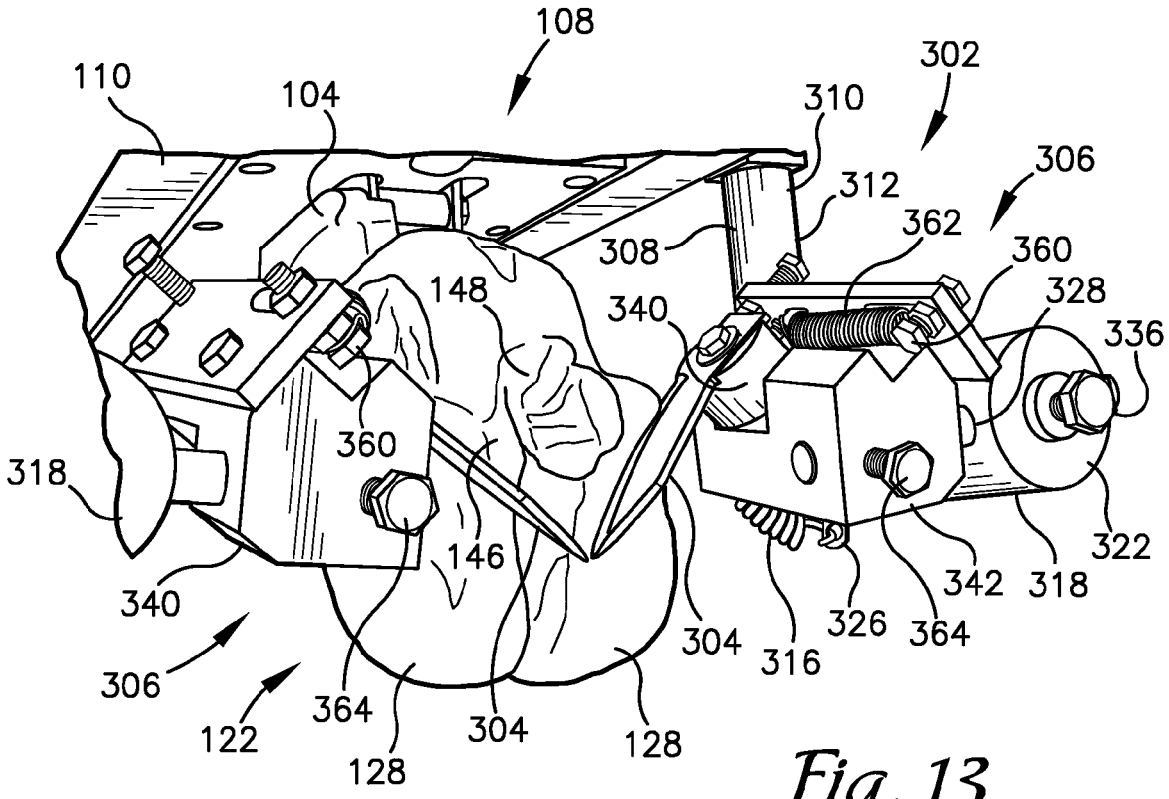
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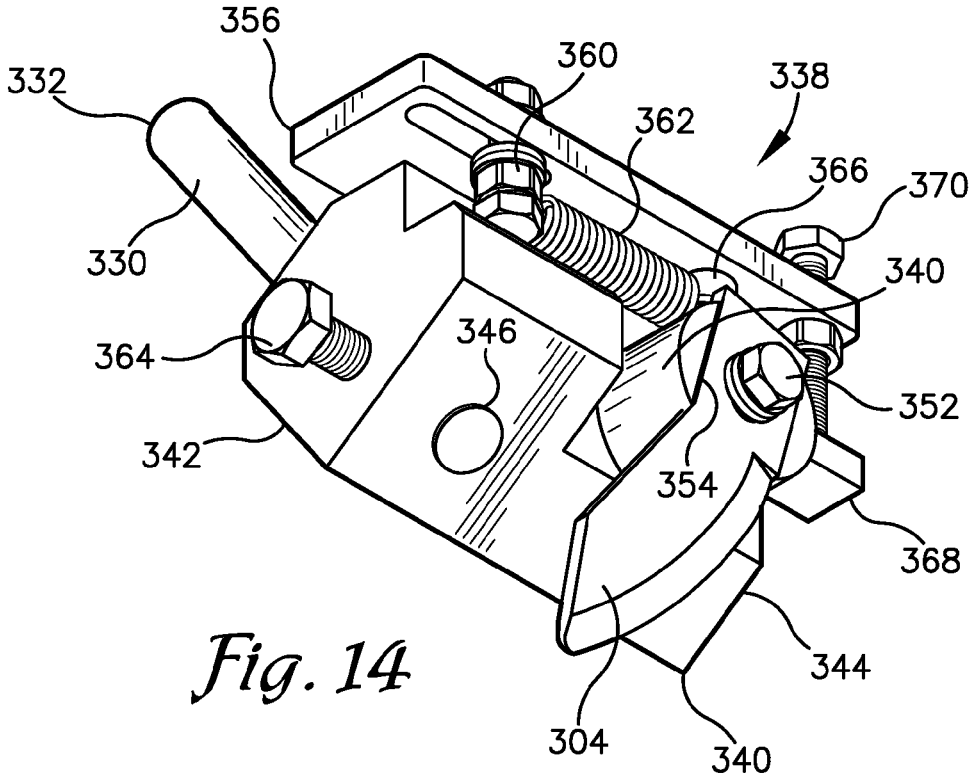
Fig. 13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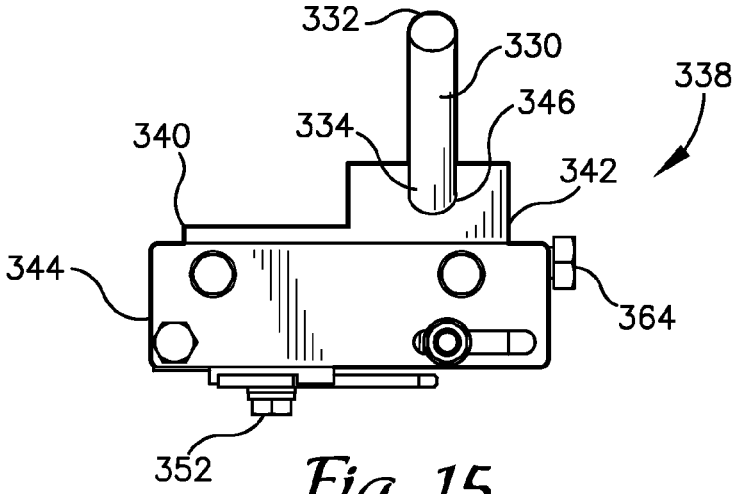

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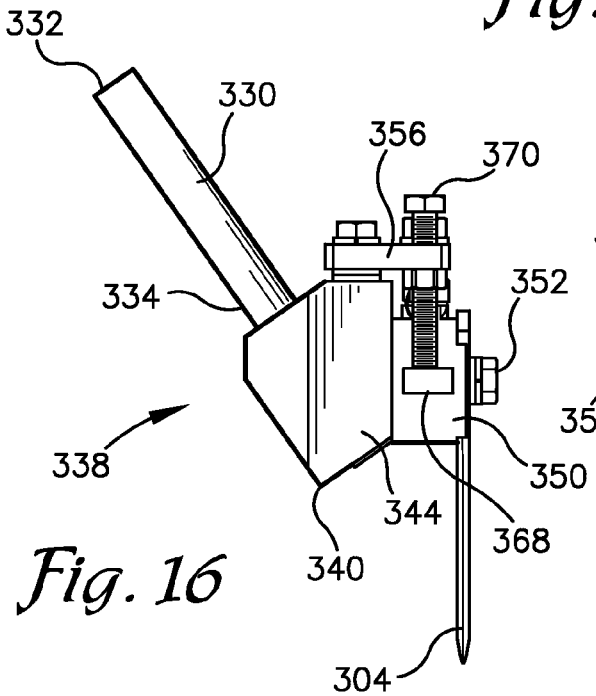

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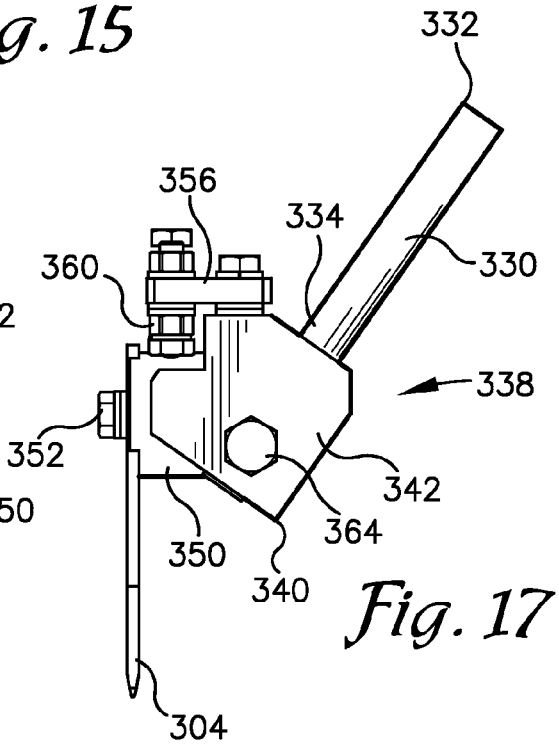

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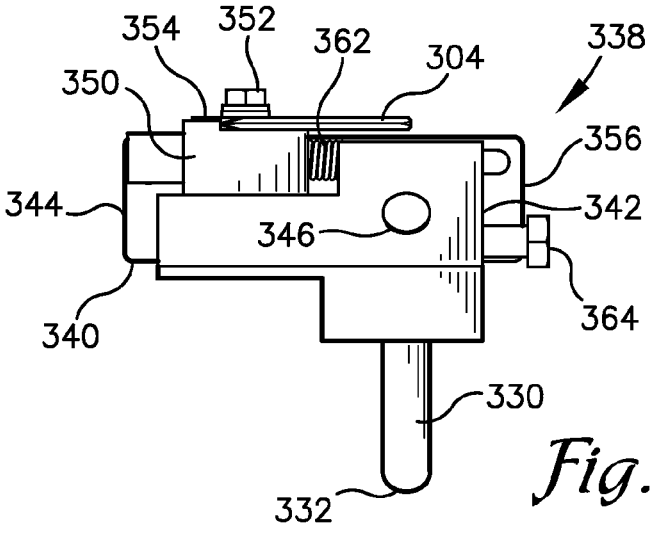

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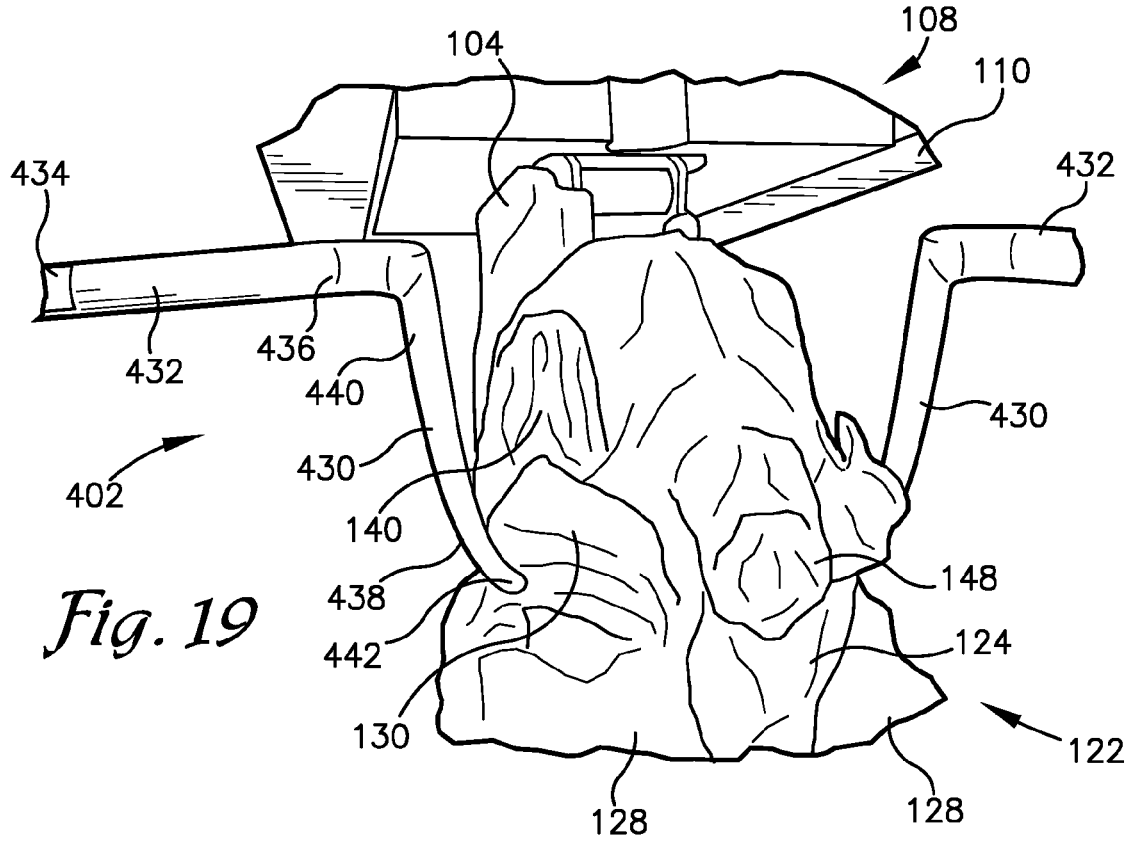
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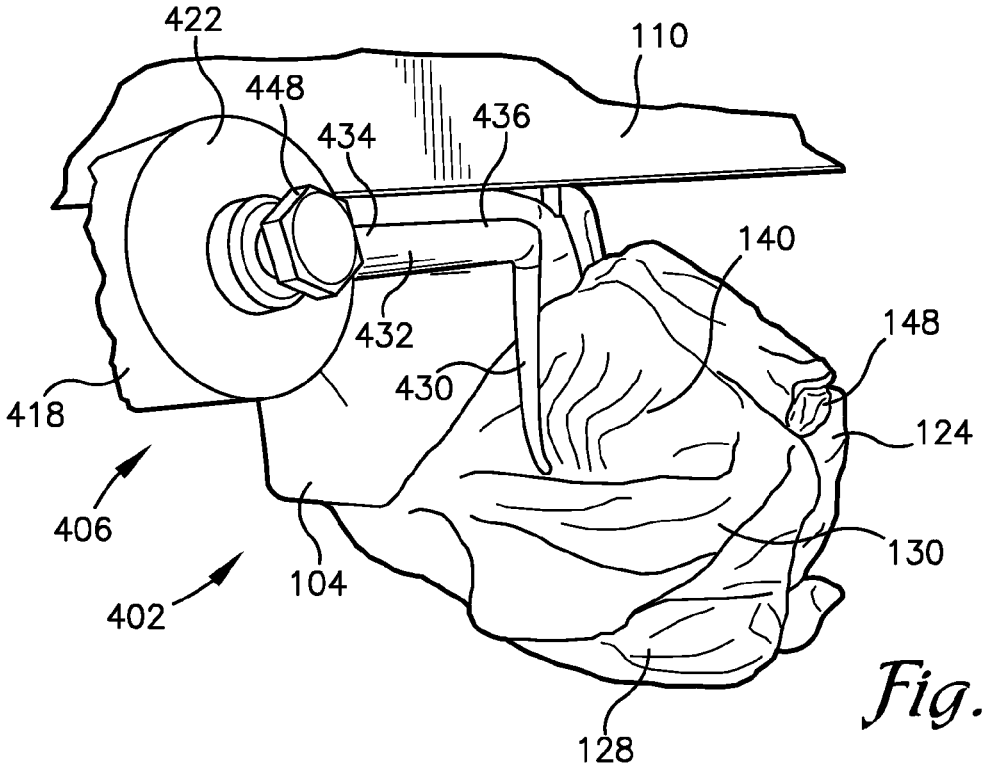
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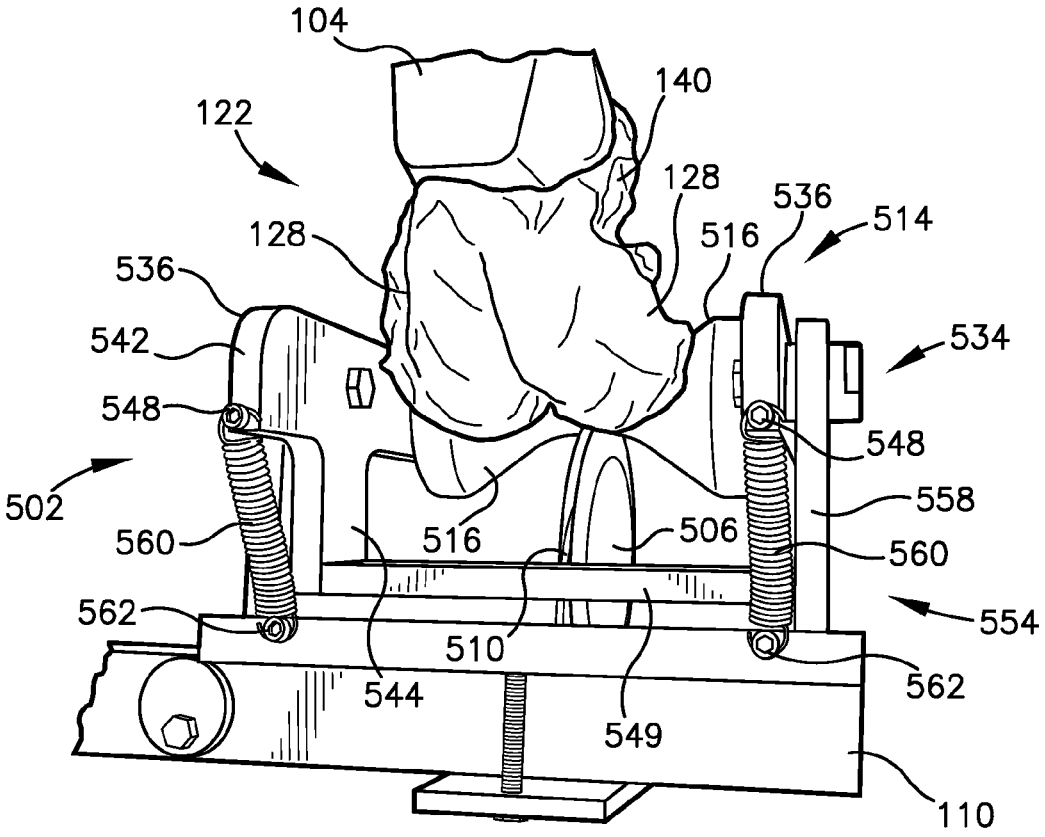
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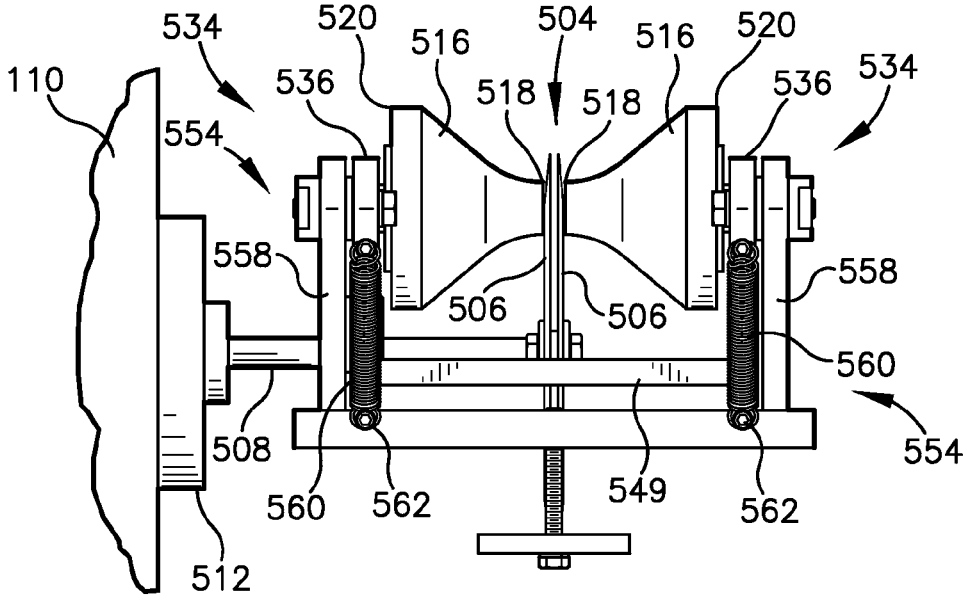
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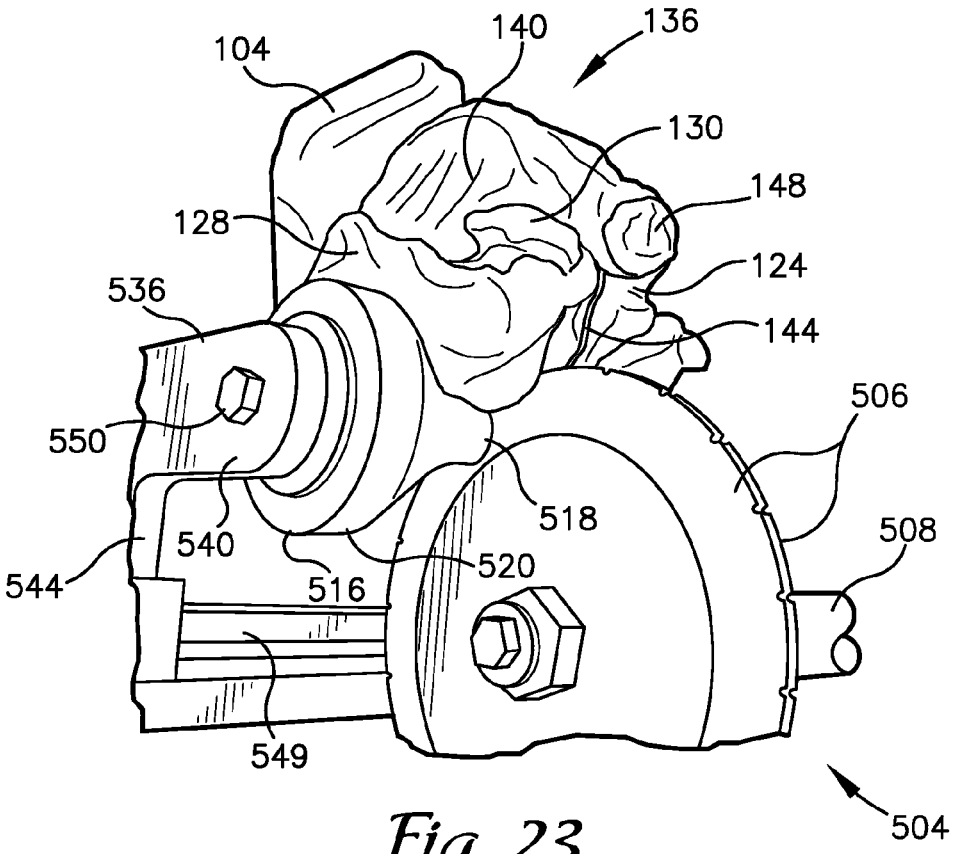
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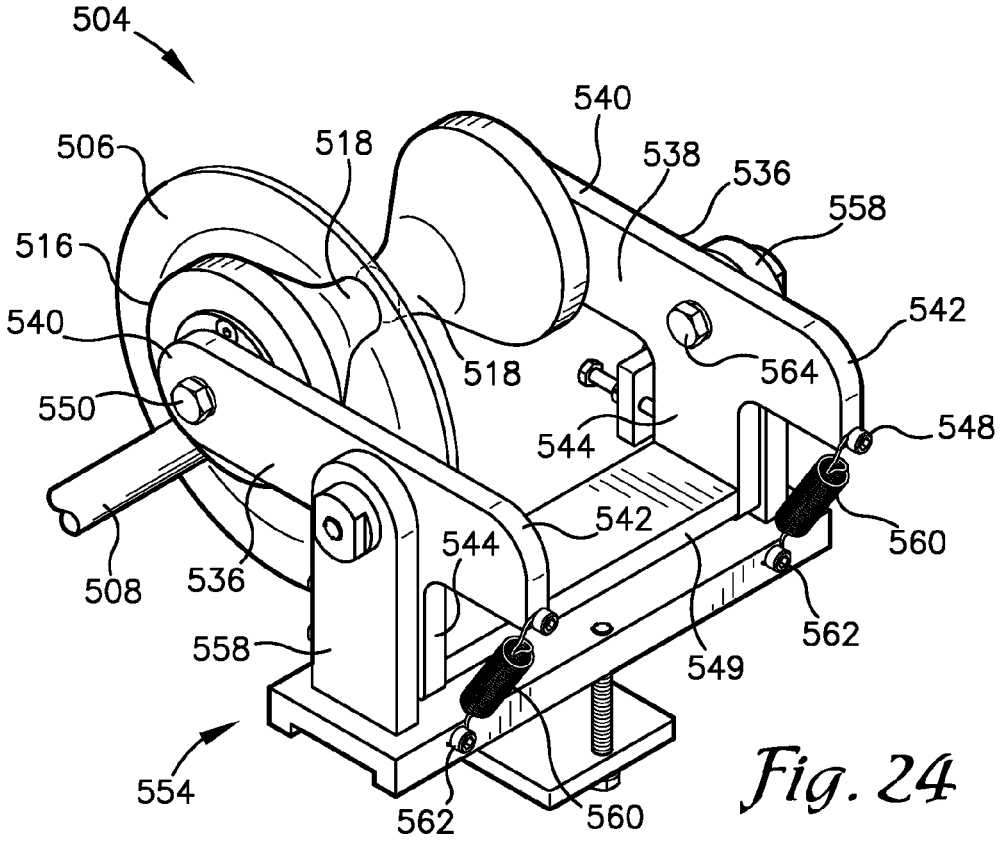
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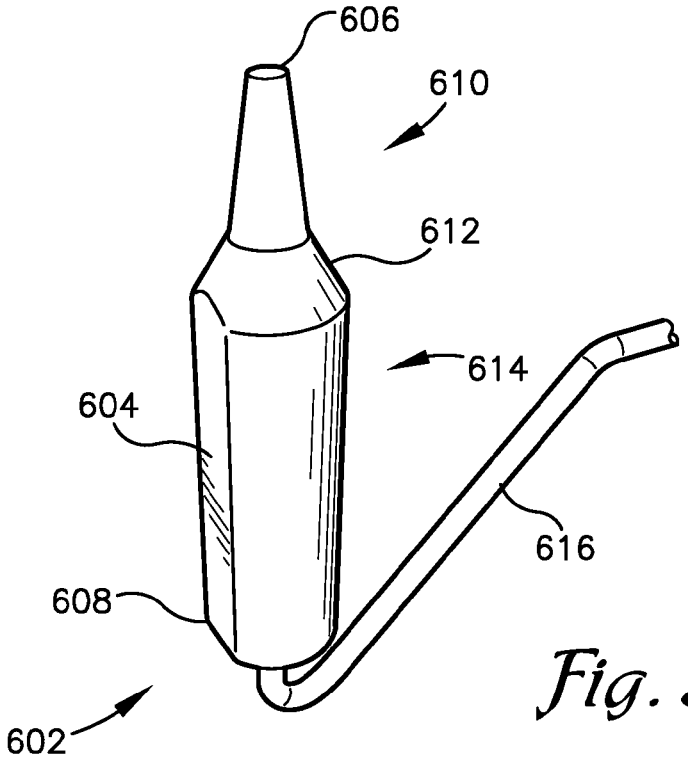
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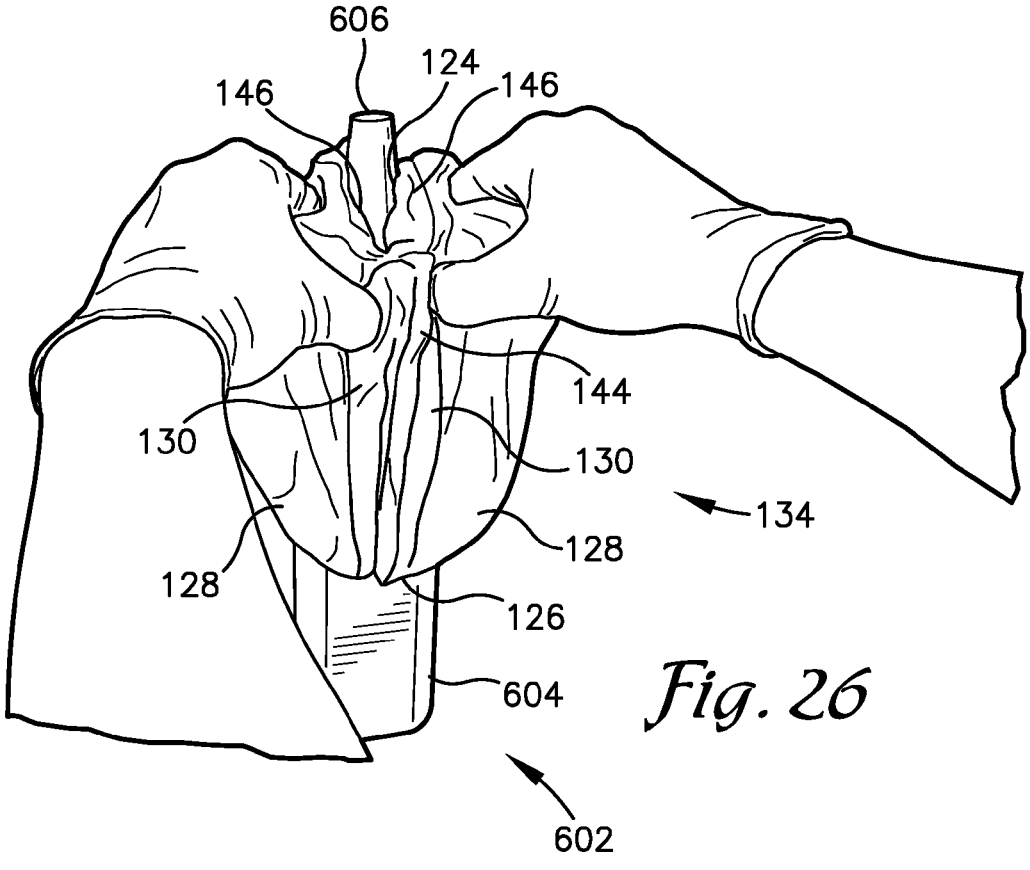
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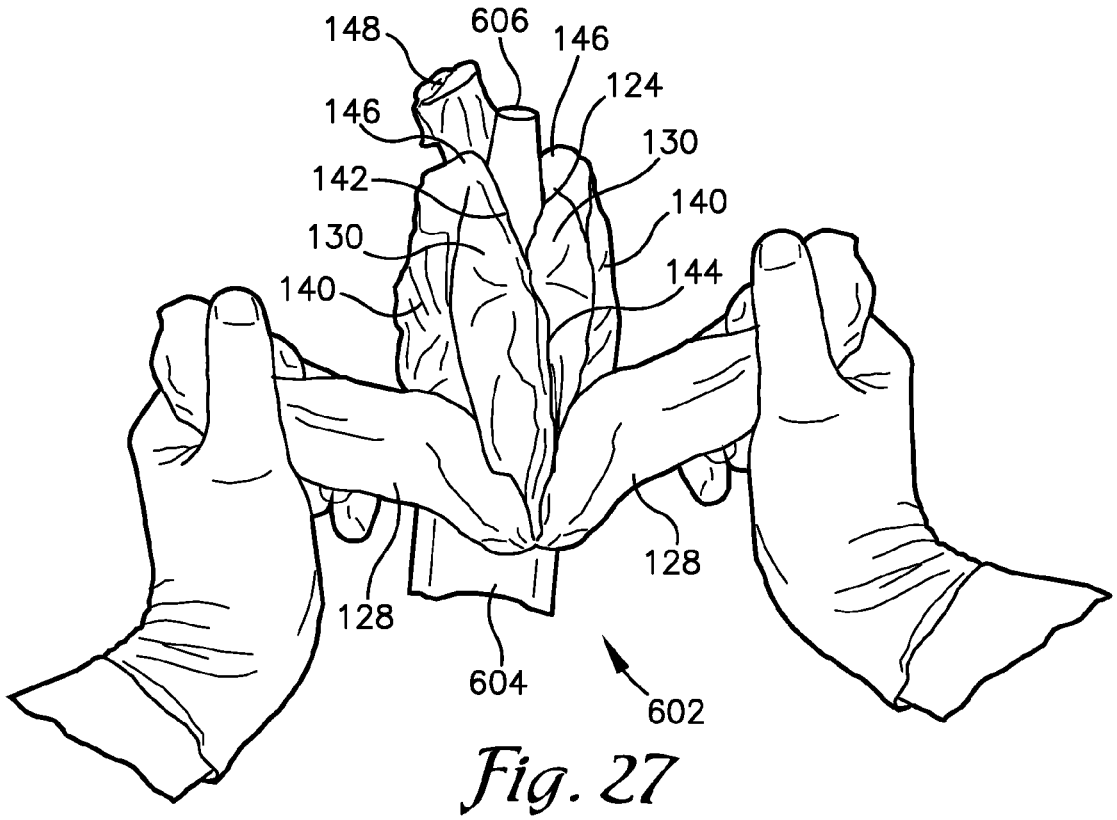
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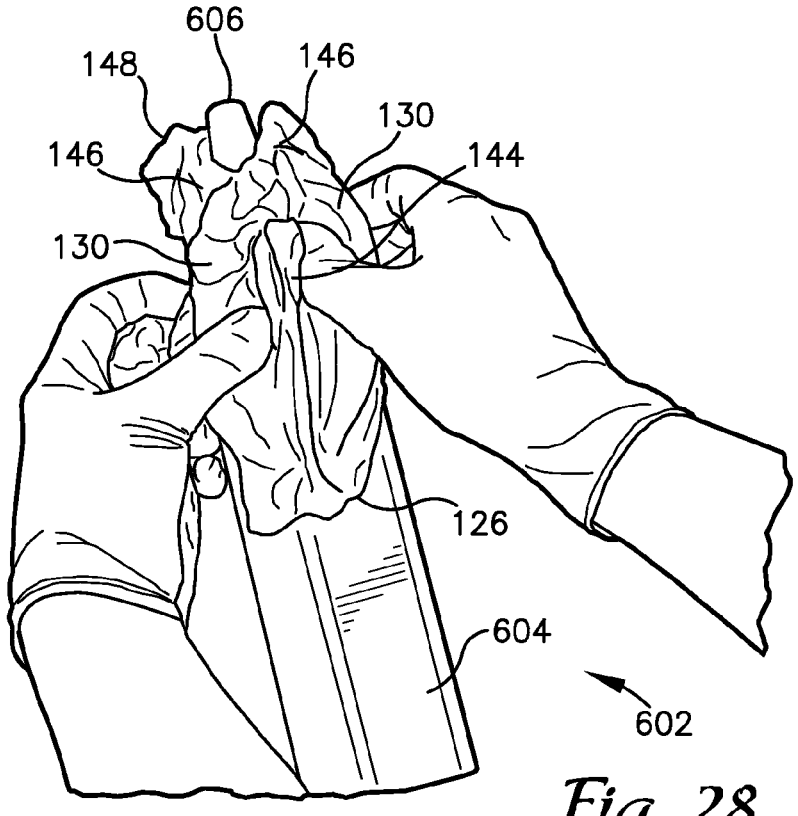
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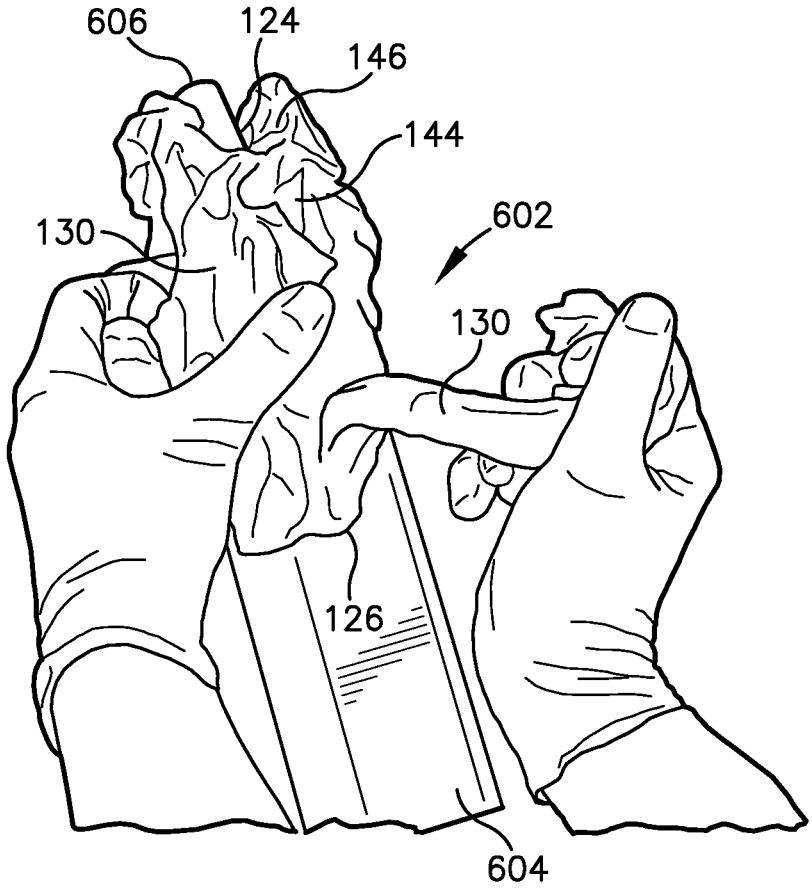

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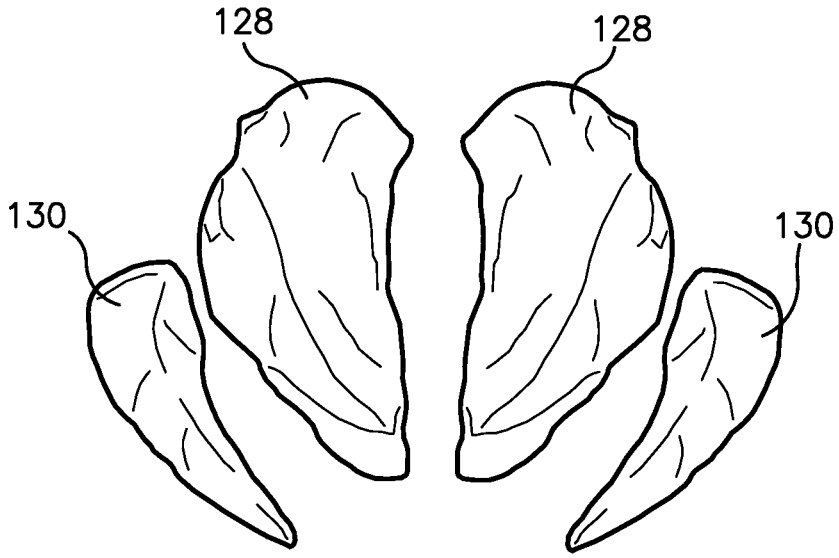

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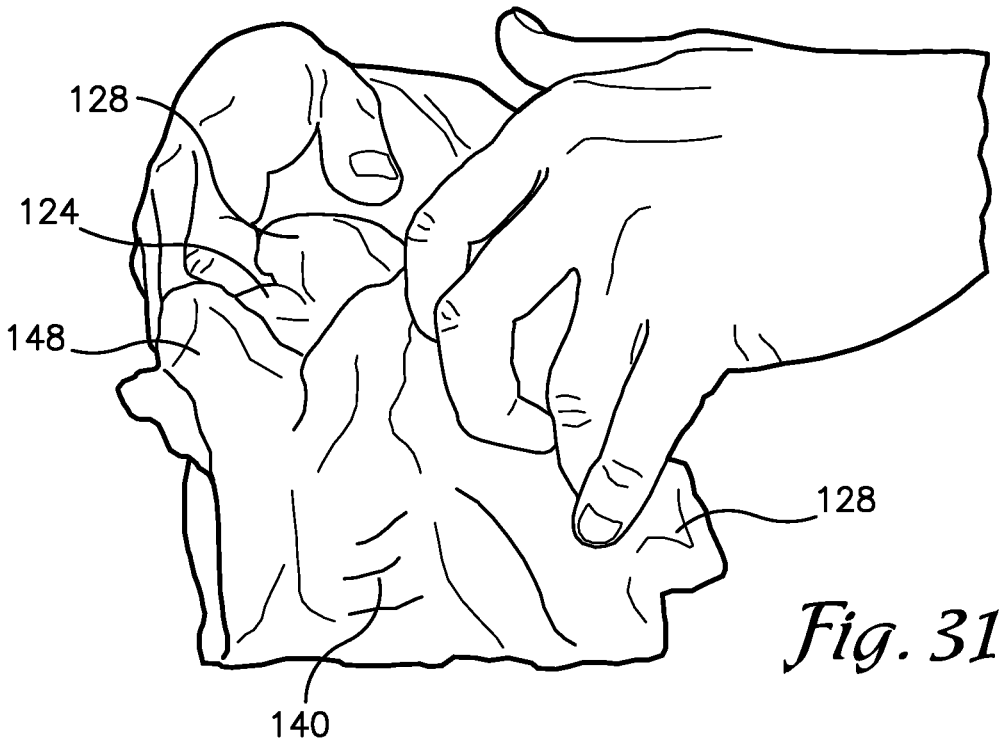

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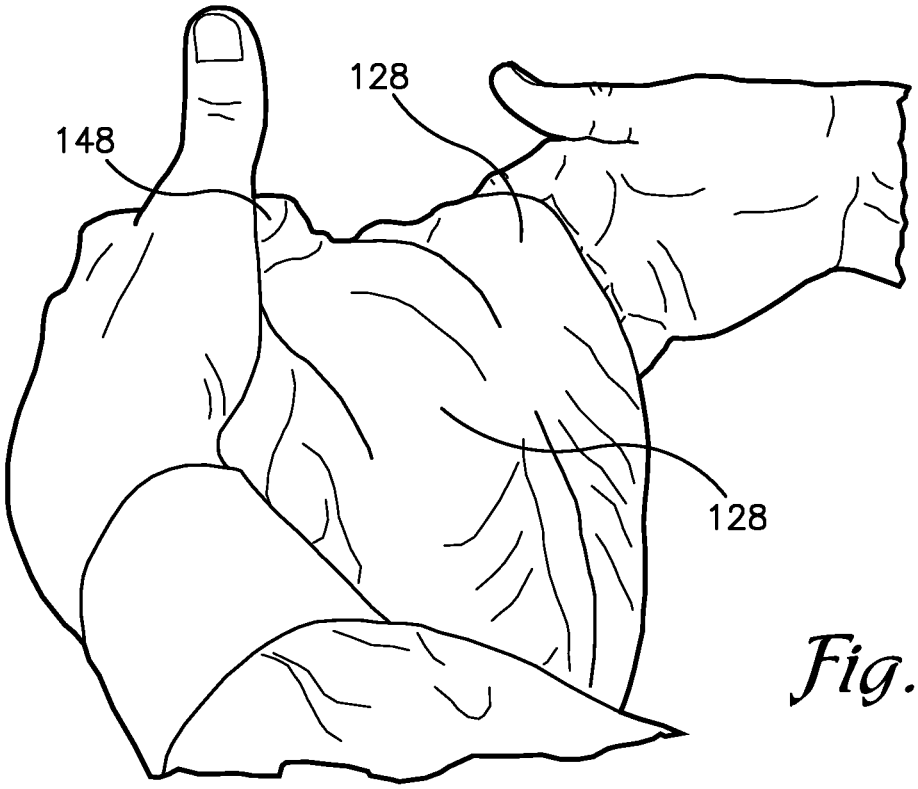

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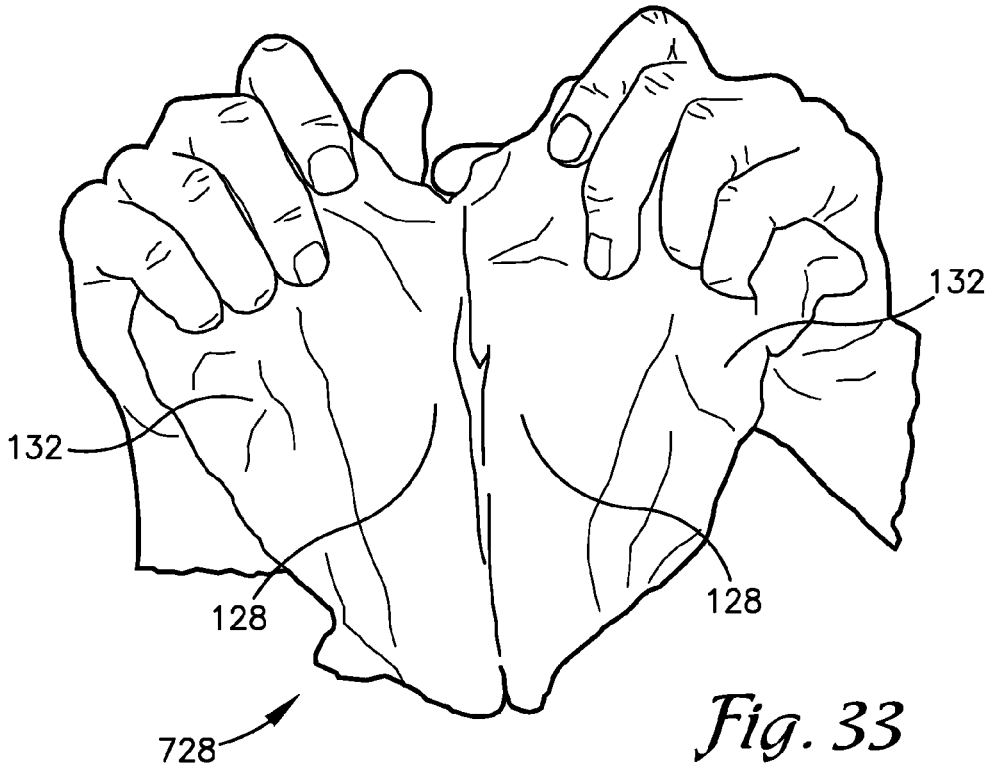

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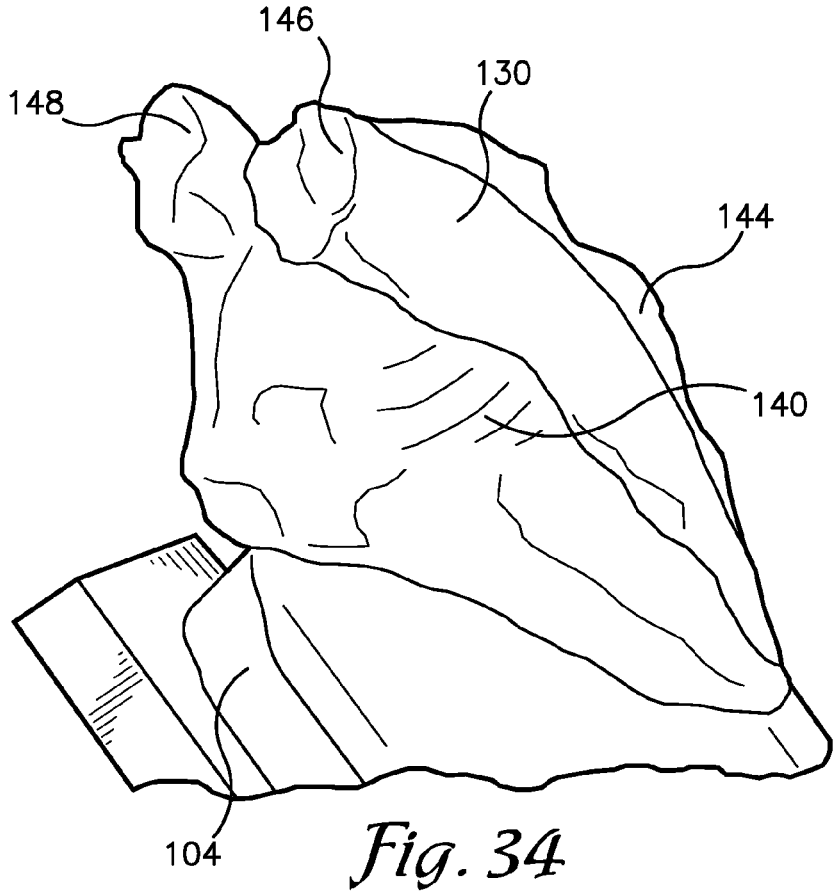

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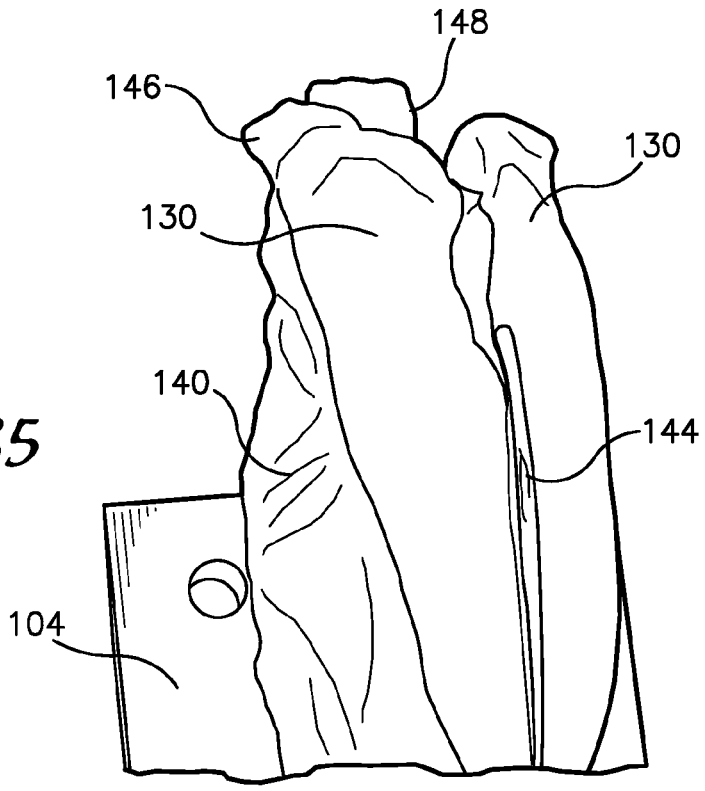

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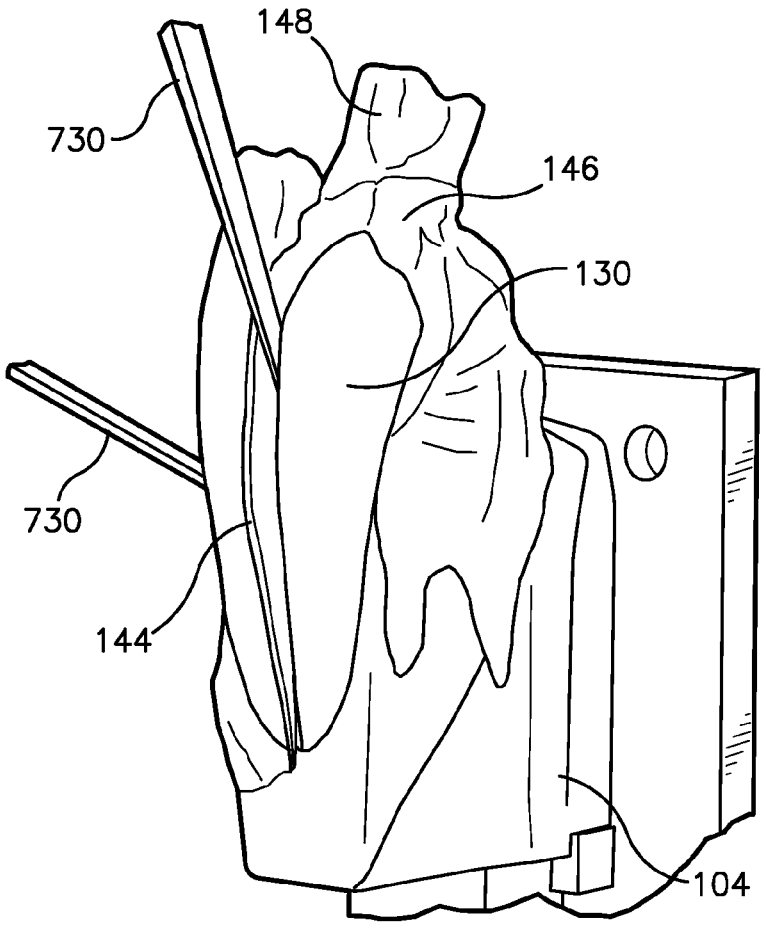

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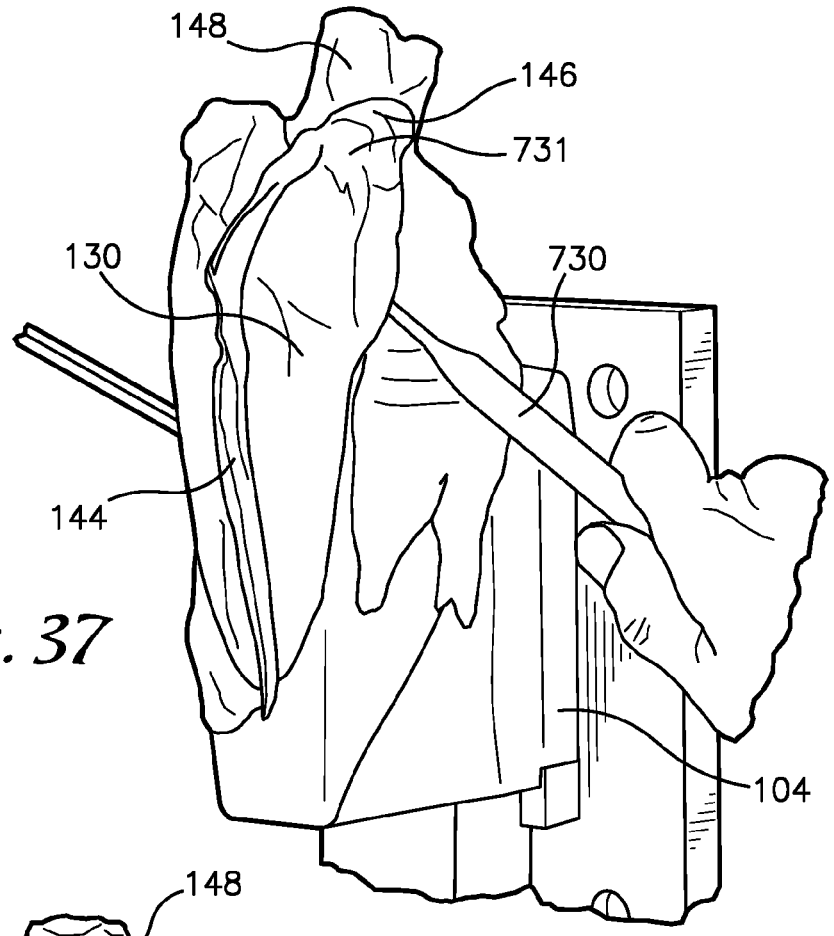
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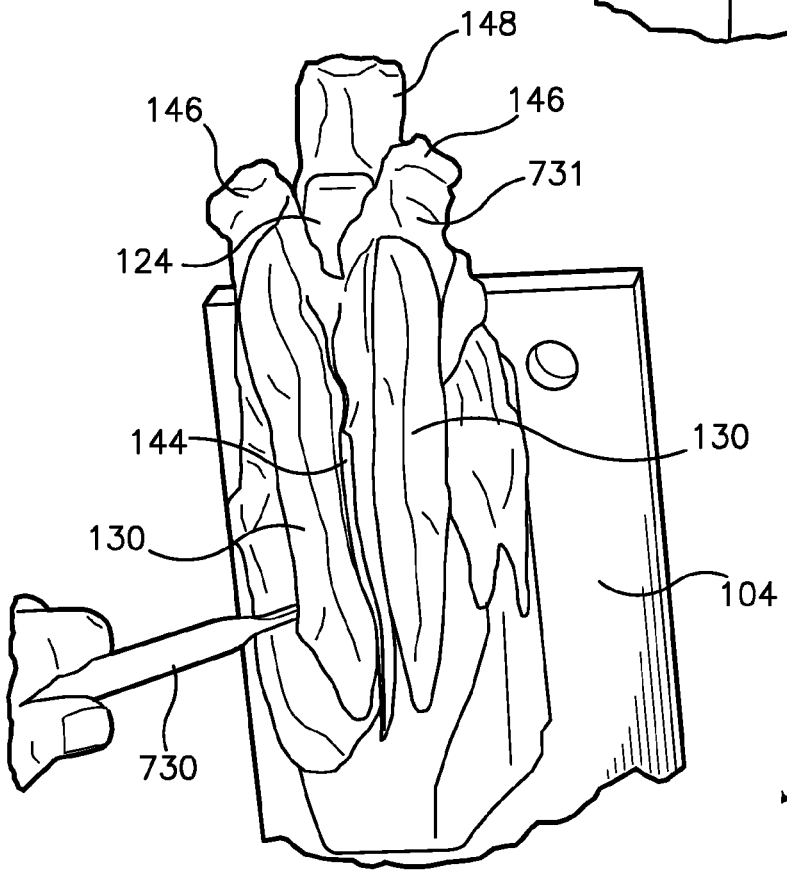
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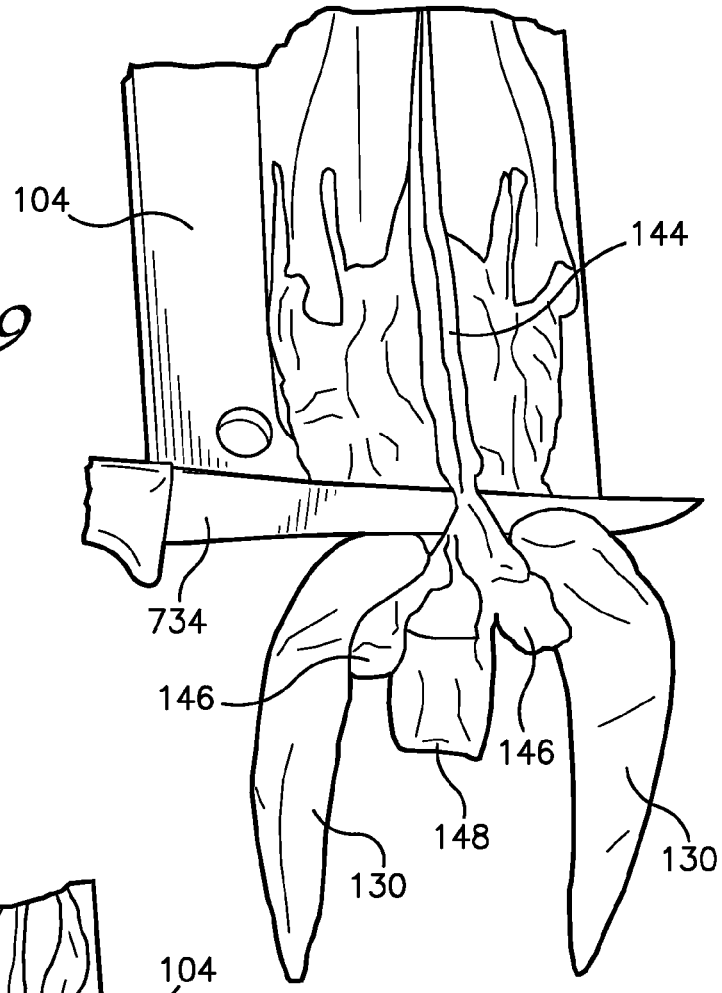

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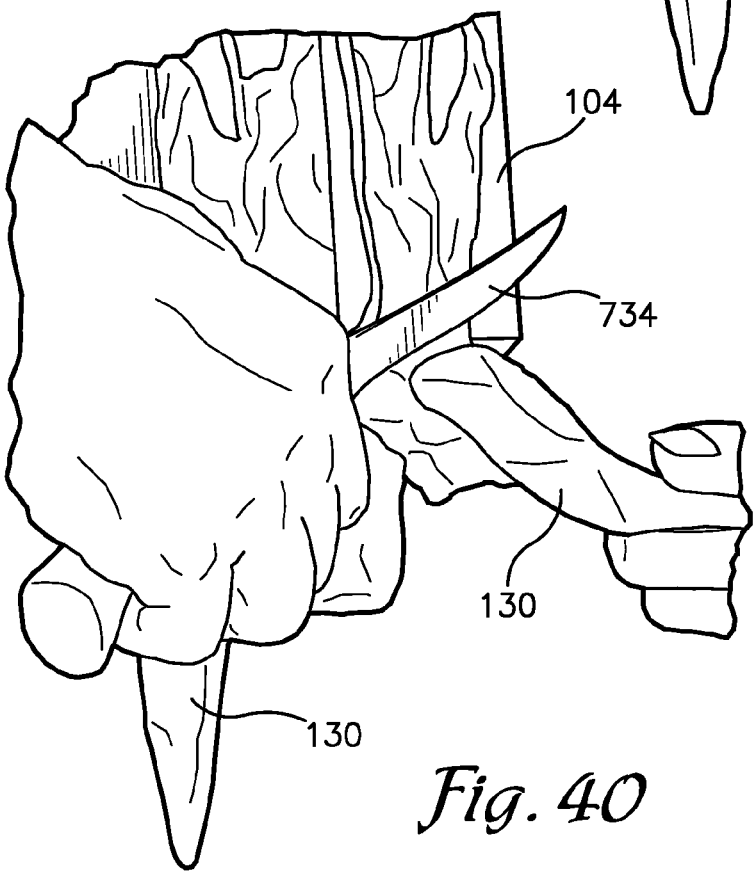

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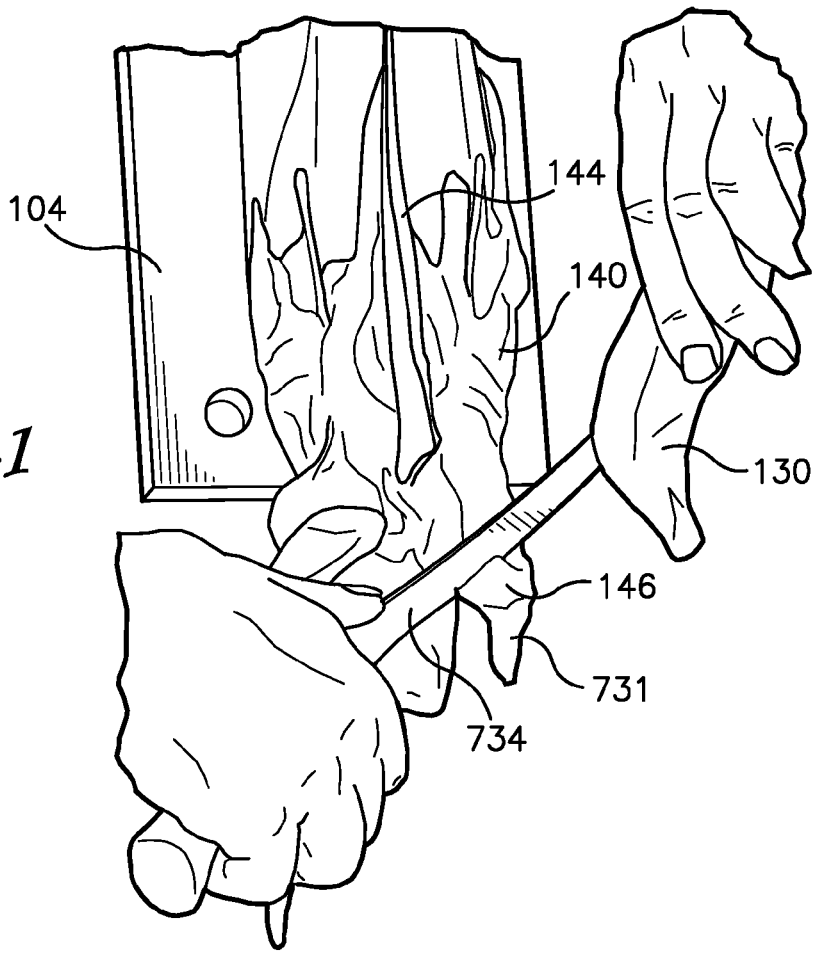

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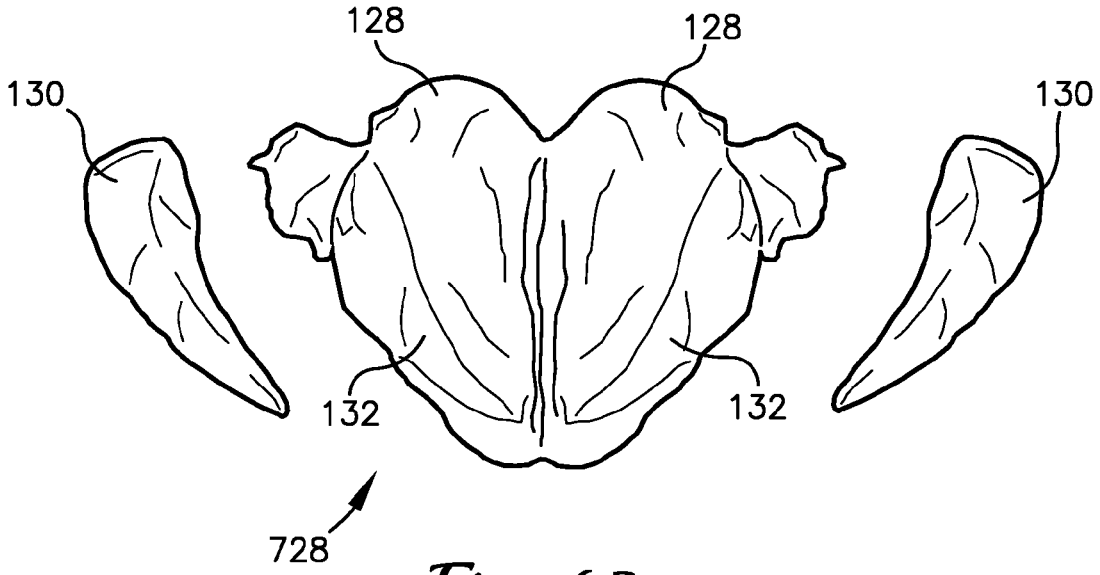

Fig. 42

COMBINATION AUTOMATED AND HAND DEBONING APPARATUS AND METHOD WITH SINGLE UNIT PROCESSING

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application No. 61/637,102, filed Apr. 23, 2012, the contents of which are hereby incorporated herein by reference.

BACKGROUND

The present disclosed subject matter relates generally to animal processing, and more specifically to an apparatus and method of partially separating the tissue from the skeletal structure of a bird during processing.

Automation of animal processing lowers the cost of food products for consumers. Automation of the process is accomplished by use of machinery that transport animal carcasses through processing stations, mechanically positions the carcasses, and mechanically removes wanted and unwanted tissues. Wanted tissues include the muscle tissue of the animal which is purchased by consumers. Eviscerated animal carcasses often undergo additional processing in order to separate the wanted tissues of the animal from the carcass for sale to consumers. Although it is advantageous to automate as many steps as possible during processing of the animal carcass, for some steps it is desirable to manually process the carcass in order to maximize the yield of the tissue harvested from the animal or to avoid the introduction of unwanted skeletal material into the harvested tissue.

SUMMARY

An apparatus and method for separating wanted tissues from a bird carcass comprises a mechanical and manual manipulation of the tissues. The mechanical manipulation includes scoring the lateral side of the carcass below the ribs between the neck opening and the vent to separate the breast tissue from the skeletal system, and separating the breast tissue and tenderloin tissue from the breast bone. The manual manipulation or hand harvesting of the wanted tissues includes: mounting the carcass on a fixture, grasping the breast tissue adjacent the neck opening, and moving the hand toward the vent to separate the breast tissue from the carcass; and grasping the tenderloin tissue adjacent the neck opening, and moving the hand toward the vent to separate the tenderloin tissue from the carcass.

Mechanical scoring of the lateral side of carcass may be accomplished by a cut assembly. The carcass may be mounted on an item mount that is connected to a conveyor system for transporting the carcass through several processing stations located about the housing of a processing machine. The cut assembly includes a blade connected to a blade mount that is biased toward the item mount for scoring the lateral side of the carcass below the ribs between the neck opening and the vent. The cut assembly may be articulated for adjusting the position of the blade relative to the carcass. The articulated assembly includes an arm, a support connected to the arm and the housing, a jig connected to the arm and the blade mount, and an extension extending between the arm and the jig. A biasing member connected to the articulated assembly biases the blade toward the item mount, and a biasing member connected to the blade mount for biasing the blade toward the item mount.

Mechanical separation of the breast tissue and tenderloin tissue from the breast bone may be accomplished by a separator assembly. The separator assembly includes a roller for supporting the ventral end of the carcass as it is advanced into engagement with two spaced apart blades that pass on either side of the breast bone and separate the breast tissue and tenderloin tissue from the breast bone. The roller may include two opposing, spaced apart rollers that each taper inward from a relatively wide base to a relatively narrow tip forming a general U-shaped concave guide. The blades are rotatably connected to a mount and pass between the spaced apart rollers to engage the carcass.

Hand harvesting of the breast tissue and tenderloin tissue after one or more of the aforementioned mechanical manipulations of the tissue may be accomplished by mounting the carcass on a fixture allowing manual removal of the tissue from the carcass. If the carcass has received a mechanical scoring of the lateral side, but no mechanical separation of the breast tissue and tenderloin tissue from the breast bone, the breast tissue may be harvested as a butterfly fillet by grasping the breast tissue adjacent the opening and moving the hands toward the vent to separate the breast tissue butterfly fillet from the carcass. The tenderloin tissue is harvested by scraping the tenderloin tissue from the carcass along the breast bone. The tenderloin tissue thereafter remains connected to the carcass adjacent the neck opening. The fixture may by reoriented to position the neck opening in the downward direction causing the tenderloins to fall from their natural positions and remaining connected to the carcass by tendons. The tenderloin is then removed from the carcass by cutting the tenderloin from the tendon.

If the carcass has received a mechanical scoring of the lateral side and a mechanical separation of the breast tissue and tenderloin tissue from the breast bone by the separator assembly, each breast is harvested by grasping the tissue adjacent the neck opening by encircling the tissue with the thumb and a finger of a hand, and moving the hand toward the vent to separate the tissue from the carcass. The tenderloin tissue is harvested by grasping the tissue adjacent the neck opening by encircling the tissue with the thumb and a finger of a hand, and moving the hand toward the vent to separate the tissue from the carcass.

The cut assembly and separator assembly may be used alone or in conjunction with other processing stations of a processing machine, and may be retrofitted to existing processing machines. Alternatively, the operations of the cut assembly or the separator assembly may be accomplished by hand, followed by hand harvesting of the breast tissue and tenderloin tissue.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings constitute a part of this specification and include exemplary embodiments of the disclosed subject matter and illustrate various objects and features thereof.

FIG. **1** is a ventral view of an exemplary bird carcass processed by the apparatus and method of the disclosed subject matter.

FIG. **2** is a side view of an exemplary bird carcass processed by the apparatus and method of the disclosed subject matter.

FIG. **3** is a dorsal view of an exemplary bird carcass processed by the apparatus and method of the disclosed subject matter.

FIG. **4** is an anterior view of an exemplary bird carcass processed by the apparatus and method of the disclosed subject matter.

FIG. **5** is a posterior view of an exemplary bird carcass processed by the apparatus and method of the disclosed subject matter.

FIG. **6** is a side elevation view of an exemplary automated deboning apparatus embodying principles of the disclosed subject matter.

FIG. **7** is an isometric view from the front of a carcass, with skin, shown on a carcass mount of the exemplary automated deboning apparatus.

FIG. **8** is a perspective view from the front, of the back skin auger of the exemplary automated deboning apparatus.

FIG. **9** is a perspective view from the front of the breast skin auger of the exemplary automated deboning apparatus.

FIG. **10** is a perspective view from the front of the back meat removal assembly of the exemplary automated deboning apparatus.

FIG. **11** is another perspective view from the front of a component of the back meat removal assembly of the exemplary automated deboning apparatus.

FIG. **12** is a perspective view from the back of a component of the back meat removal assembly of the exemplary automated deboning apparatus.

FIG. **13** is a perspective view from the front of the cut assembly of the exemplary automated deboning apparatus encountering a carcass.

FIG. **14** is a perspective view of the cut assembly of the exemplary automated deboning apparatus.

FIG. **15** is a top view of the cut assembly of the exemplary automated deboning apparatus.

FIG. **16** is a rear view of the cut assembly of the exemplary automated deboning apparatus.

FIG. **17** is a front view of the cut assembly of the exemplary automated deboning apparatus.

FIG. **18** is a bottom view of the cut assembly of the exemplary automated deboning apparatus.

FIG. **19** is a perspective view from the front of the scraper assembly of the exemplary automated deboning apparatus.

FIG. **20** is a perspective view from the front of the scraper assembly of the exemplary automated deboning apparatus.

FIG. **21** is a perspective view from the rear of the separator assembly of the exemplary automated deboning apparatus.

FIG. **22** is a rear elevation view of the separator assembly of the exemplary automated deboning apparatus.

FIG. **23** is a perspective view from the front of the separator assembly of the exemplary automated deboning apparatus.

FIG. **24** is a perspective view from the rear of the separator assembly of the exemplary automated deboning apparatus.

FIG. **25** is a perspective view from the front of a fixture of the exemplary manual tissue harvesting apparatus and method of the disclosed subject matter.

FIG. **26** is a perspective view from the front of the manual harvesting of the breast tissue of a carcass on a fixture according to an embodiment of the exemplary manual tissue harvesting apparatus and method.

FIG. **27** is a perspective view of the manual harvesting of the breast tissue of a carcass on a fixture according to an embodiment of the exemplary manual tissue harvesting apparatus and method.

FIG. **28** is a perspective view from the front of the manual harvesting of the tenderloin tissue of a carcass on a fixture according to an embodiment of the exemplary manual tissue harvesting apparatus and method.

FIG. **29** is a perspective view from the front of the manual harvesting of the tenderloin tissue of a carcass on a fixture according to an embodiment of the exemplary manual tissue harvesting apparatus and method.

FIG. **30** is a view of the breast tissue and tenderloin tissue harvested from a carcass using a fixture according to an embodiment of the exemplary manual tissue harvesting apparatus and method.

FIG. **31** is a perspective view from the back of the manual harvesting of the breast tissue butterfly fillet of a carcass on a fixture according to an embodiment of the exemplary manual tissue harvesting apparatus and method.

FIG. **32** is a perspective view from the front of the manual harvesting of the breast tissue butterfly fillet of a carcass on a fixture according to an embodiment of the exemplary manual tissue harvesting apparatus and method.

FIG. **33** is an elevation view of the manual harvested breast tissue butterfly fillet with back meat attached according to an embodiment of the exemplary manual tissue harvesting apparatus and method.

FIG. **34** is a lateral side elevation view of a carcass on a fixture with the breast tissue butterfly fillet removed.

FIG. **35** is a perspective view of the ventral end of a carcass on a fixture with the breast tissue butterfly fillet removed.

FIG. **36** is a perspective view of a carcass on a fixture with the neck opening positioned upward, and scraping the tenderloin tissue from the breast bone using a tool.

FIG. **37** is a perspective view of a carcass on a fixture with the neck opening positioned upward, and scraping the tenderloin tissue from the breast bone using a tool.

FIG. **38** is a perspective view of the ventral end of a carcass on a fixture with the neck opening positioned upward, and scraping the tenderloin tissue from the breast bone using a tool.

FIG. **39** is a perspective view of the ventral end of a carcass on a fixture with the neck opening positioned downward, and the tenderloin tissues released from their natural positions.

FIG. **40** is a perspective view of the ventral end of a carcass on a fixture with the neck opening positioned downward, and the tenderloin tissue being cut from the carcass.

FIG. **41** is a perspective view of the ventral end of a carcass on a fixture with the neck opening positioned downward, and the tenderloin tissue being cut from the carcass.

FIG. **42** is a perspective view of the breast tissue butterfly fillet with back meat attached, and the tenderloin tissue removed from the carcass.

DETAILED DESCRIPTION

As required, detailed aspects of the disclosed subject matter are disclosed herein; however, it is to be understood that the disclosed aspects are merely exemplary of the disclosed subject matter, which may be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art how to variously employ the disclosed subject matter in virtually any appropriately detailed structure.

Certain terminology will be used in the following description for convenience in reference only and will not be limiting. For example, up, down, front, back, left and right refer to the apparatus as orientated in the view being referred to. The words "inwardly" and "outwardly" refer to directions toward and away from, respectively, the geometric center of the aspect being described and designated parts thereof. Said terminology will include the words specifically mentioned, derivatives thereof, and words of similar meaning.

Referring to FIG. **6**, reference numeral **102** generally designates an automated deboning apparatus embodying principles of the disclosed subject matter. The automated debon-

ing apparatus **102** includes several processing stations, located about a housing **110**, that mechanically remove wanted and unwanted tissues from an eviscerated bird carcass **122**, and mechanically manipulate the tissues of the carcass **122** to maximize the yield of the tissues harvested from the carcass **122**. The general process below may be described as skinning of the carcass **122** followed by tissue separation and deboning. Components of the carcass **122**, including identification of the wanted tissues, will be presented first followed by a discussion of the mechanical manipulation of the tissues of the carcass **122** by the automated deboning apparatus **102** and manual manipulation and harvesting of the wanted tissues.

Referring to FIGS. **1-5**, an exemplary bird carcass **122** is shown and described, and is commonly known as a chicken front half, without wings, with skin. As such, the carcass **122** is shown without the head and neck, wings, legs, and tail. Although a chicken is shown and described, it will be appreciated that various birds may be processed according to the disclosed subject matter. The carcass **122** extends between a neck opening **124** at the anterior end and a vent **126** at the posterior end, which generally defines an anterior-posterior axis. The carcass **122** has breast **128** tissue at a ventral end **134** and back meat **132** tissues at a dorsal end **136**, which generally defines a ventral-dorsal axis. The carcass **122** shown has been eviscerated, and some skeletal material remains providing a support structure for the remaining tissues. The skeletal material remaining includes: a backbone **148** along the dorsal end **136**; ribs **140** adjacent to the backbone **148**, beneath the back meat **132** and adjacent the breast **120** and tenderloin **130**; a wishbone **142**; and breast bone **144** along the ventral end **134** beneath the breast **128** and tenderloin **130**. The breast **128** is superficial to the tenderloin **130**, and the tenderloin **130** is adjacent to the breast bone **144**. Accordingly, the wanted tissues of the carcass **122** addressed herein include the back meat **132**, breast **128**, and tenderloin **130**.

Referring to FIG. **7**, the carcass **122** is shown on a carcass mount **104** connected to a conveyor system **108**. A retention hook (not shown) at the front of the carcass mount **104** engages the internal body cavity of the carcass **122** to retain the carcass **122** on the carcass mount **104** during processing. The carcass **122** is advanced through each of the processing apparatuses below by the conveyor system **108**. Because the carcass **122** has bilateral symmetry, the various processing apparatuses described below may be conducted on one side of the carcass **122** or on both sides of the carcass **122**. In the automated deboning apparatus **102** shown in FIGS. **6-24**, the carcass **122** is positioned so that the dorsal end **136** is facing the conveyor system **108** and the ventral end **134** is facing away from the conveyor system **108** so that the particular arrangement of the various processing apparatuses described below may operate on the carcass **122**. It will be appreciated that the particular automated deboning apparatus **102** and the various processing apparatuses disclosed herein may be arranged in any number of different ways, and that operation of the various processing apparatuses upon the carcass **122** are not dependent upon their physical or special relationship to each other, rather, the results of the processing apparatuses are particular to their position relative to the carcass **122**.

Referring to FIG. **8**, the carcass **122** first advances through a skin removal assembly **152**. An irrigation system **112**, such as the one shown in FIG. **10**, expels fluid, including water, upon the carcass **122**, and upon the processing apparatuses below throughout processing to cleanse the carcass **122** and processing apparatuses of loose tissue and debris. The skin removal assembly **152** includes a back skin auger **154** and a breast skin auger **166**. Referring to FIG. **8**, the carcass **122** is shown after advancing from left to right through the back skin auger **154**. The back skin auger **154** includes a pair of parallel mesh gears **156** presenting a pinching surface for removing the skin from the dorsal end **136** of the carcass **122**. The gears **156** are generally aligned at an oblique angle relative to the anterior-posterior axis of the carcass **122** and rotate on a mount **158** that is biased toward the carcass **122** by a biasing member including a spring. A power source is operably connected to and drives the gears **156**.

Referring to FIG. **9**, the carcass **122** is shown next advancing into engagement with the breast skin auger **166**. The breast skin auger **166** includes a pair of parallel mesh gears **168** presenting a pinching surface for removing the skin from the ventral end **134** of the carcass **122**. The gears **168** are generally aligned parallel to the anterior-posterior axis of the carcass **122**, and rotate on a mount **170** that is biased toward the carcass **122** by a biasing member including a spring. A power source is operably connected to and drives the gears **168**. Each of the back skin auger **154** and breast skin auger **166** are shown as a pair of meshed gears.

Referring to FIGS. **10-12**, the carcass **122** is shown next advancing into engagement with a back meat removal assembly **202** for removal of the back meat **132** from the ribs **140**. The back meat removal assembly **202** includes a scraper **204** connected to an arm **206**. Each arm **206** is pivotally mounted to the housing **110**. The arm **206** aligns the scraper **204** with the carcass **122** to scrape the back meat **132** from the ribs **140**. Thereafter, the back meat **132** remains connected to the carcass **122** adjacent to the breast **128** tissue (FIG. **11**). The back meat **132** is harvested from the carcass **122** by a blade **214**. As the carcass **122** advances toward a support **210** with an adjacent rotating blade **214**, the support **210** guides the back meat **132** into engagement with the rotating blade **214** whereby the back meat **132** is separated from the carcass **122** and is collected for further processing (FIGS. **11-12**). The back meat removal assembly **202** is shown with a pair of scrapers **204** and a pair of blades **214**.

Referring to FIG. **13**, the carcass **122** is next advanced into engagement with a cut assembly **302**. The cut assembly **302** mechanically manipulates the tissues of the carcass **122** by scoring the tissue, thereby facilitating subsequent mechanical and manual manipulation of the tissues. A cut assembly **302** is shown positioned on opposite lateral sides of the carcass **122**. Each cut assembly **302** includes a blade **304** connected to a mount **306**. The blade **304** is manufactured from a resilient material including stainless steel. The mount **306** may be a monolithic device connecting the blade **304** to the housing **110**. Alternatively, the mount **306** is an articulated assembly capable of aligning, and biasing the blade **304** with the carcass **122** as it engages the tissues of the carcass **122**. The articulated assembly generally includes an arm **318** connected to the housing **110** by a support **308**, and connected to the blade **304** by a jig **338**.

The support **308** is manufactured from a resilient material including stainless steel, and extends between a first end **310** and a second end **312**. The first end **310** is connected to the housing **110**, and the second end **312** is connected to the arm **318**. The arm **318** is manufactured from a resilient material including nylon, and extends between a first end and a second end **322**. The first end has an aperture for rotatably receiving the second end **312** of the support **308**. An attachment at the second end **312** of the support **308**, and an attachment **326** at the first end of the arm **318** are connected by a biasing member **316** including a spring, band, or other structure that provides biasing characteristics. The attachments are positioned whereby the biasing member **316** is under tension thereby causing the arm **318** to be biased inward toward the carcass

122 aligning the blade 304 with the carcass 122 and providing the blade 304 with a lateral force aiding the cutting of the tissue. Alternatively, the mount 306, or individually each support 308, may be biased by a biasing apparatus directly connected to the support 308, such as an actuator whereby the connection between the support 308 and arm 318 are fixed.

An extension 330 mounts the jig 338 inward of the arm 318. The extension 330 extends between a first end 332, received within an aperture 328 in the second end 322 of the arm 318, and a second end 334, received within an aperture 346 within the first end 342 of the body 340 of the jig 338. A fastener including a threaded member 336 releasably secures the first end 332 within the aperture 328, and a fastener including a threaded member 364 releasably secures the second end 334 within the aperture 346. Adjustment of the threaded members 336 and 364 allows the spacing between the arm 318 and jig 338 to be adjusted, and the vertical alignment of the jig 338 to be adjusted, for adjusting the alignment of the blade 304 with the carcass 122.

Referring to FIGS. 14-18, the jig 338 generally includes a body 340 and a blade mount 350. The body 340 is manufactured from a resilient material including nylon, and extends between a first end 342 and a second end 344. The blade mount 350 is located at the second end 344 and extends upward and inward toward the carcass 122 for mounting the blade 304 at an angle to the carcass 122. Positioning the blade 304 at an angle to the carcass 122 allows the blade 304 to cut the breast 128 tissue on the ventral side of the shoulder 146, and generally along the ventral side of the ribs 140 where the breast 128 attaches to the carcass 122. The blade 304 is releasably secured to the blade mount 350 by a fastener 352 including a threaded member. The forward edge of the blade 304 may rest against a stop 354 extending from the surface of the blade mount 350 thereby providing the blade 304 a surface to bias against when rotating with the blade mount 350. The fastener 352 extends through the blade mount 350 and is received within an aperture in the second end 344 thereby permitting the blade mount 350 to rotate about the fastener 352. In an embodiment, a bracket 356 secured to the body 340 provides an attachment 360 for an end of a biasing member 362. The opposite end of the biasing member 362 is attached to a fastener 366 adjustably connected to the blade mount 350. The biasing member 362 allows the blade 304 to rotate forward as it encounters the carcass 122, and applies pressure to the blade 304 for cutting the tissue. Adjusting the distance between the attachment 360 and the fastener 366 may vary the tension of the biasing member 362 upon the blade mount 350. Alternatively, the biasing member 362 may include a band or other structure that provides biasing characteristics. A stop 368 on the blade mount 350 allows the angle of the blade 304 to be adjusted by a threaded fastener 370. The fastener 370 extends from the bracket 356 allowing adjustment of the blade 304 position.

In use, the mount 306 aligns the blade 304 with the advancing carcass 122 so that a cut or score is made in the tissue beginning generally at a point outside and below the shoulder 146, and generally outside and below the upward arms of the wishbone 142. The cut then extends toward the posterior end of the carcass 122 as the blade 304 travels laterally along the length of the carcass 122 generally on the ventral side of the ribs 140. The cut terminates generally adjacent the posterior end of the carcass 122 as the carcass 122 exits the cut assembly 302. The cut at the point outside and below the shoulder 146, and outside and below the upward arms of the wishbone 142 facilitate removal of the breast 128 tissue and tenderloin 130 tissue during manual harvesting of the wanted tissues described in more detail below. As with the processing apparatuses above, a pair of cut assemblies 302 are shown.

Referring to FIGS. 19-20, the carcass 122 is next advanced into engagement with a scraper assembly 402. The scraper assembly 402 has a tool 430 that generally conforms to the side profile of the carcass mount 104. The scraper assembly 402 mechanically manipulates the tissues of the carcass 122 as the carcass 122 is advanced into the tool 430 causing the tool 430 to pass through the connective tissue holding the breast 128 tissue to the tenderloin 130 tissue, and the breast 128 tissue to the skeleton, partially separating the breast 128 tissue from the tenderloin 130 and skeleton, and thereby facilitating subsequent mechanical and manual manipulation of the tissues. Two scraper assemblies 402 are shown positioned on opposite lateral sides of the carcass 122.

Each scraper assembly 402 includes a tool 430 with a curved member 438 connected to a mount 406. The mount 406 generally includes an arm 418, connected to the housing 110 by a support. The support is manufactured from a resilient material including stainless steel, and extends between a first end and a second end. The first end is connected to the housing 110, and the second end is connected to the first end of the arm 418. The arm is manufactured from a resilient material including nylon, and extends between a first end and a second end 422. The first end has an aperture for receiving the second end of the support. An attachment at the second end of the support, and an attachment at the first end of the arm 418 are connected by a biasing member including a spring, band, or other structure that provides biasing characteristics. The attachments are positioned whereby the biasing member is under tension thereby causing the arm 418 to be biased inward toward the carcass 122 aligning the curved member 438 with the carcass 122 and providing the curved member 438 with a lateral force aiding the scraping of the tissue. Alternatively, the support may be biased by a biasing apparatus directly connected to the support such as an actuator.

An elongated body 432 mounts the tool 430 inward of the arm 418. The body 432 extends between a first end 434, received within an aperture in the second end 422 of the arm 418, and a second end 436. A fastener including a threaded member 448 releasable secures the first end 434 within the aperture. Adjustment of the threaded member 448 allows the spacing between the curved member 438 and the carcass 122 to be adjusted. The curved member 438 extends between a first end 440, connected to the second end 436 of the body 432, and a second end 442.

Referring to FIG. 21, the carcass 122 is next advanced into engagement with a separator assembly 502. The separator assembly 502 mechanically manipulates the tissues of the carcass 122 by cradling the breast 128 tissue with a guide assembly 514 as a blade assembly 504 separates the breast 128 tissue and tenderloin 130 tissue from the breast bone 144, thereby facilitating subsequent manual manipulation of the tissues.

The guide assembly 514 generally includes opposing, spaced apart rollers 516 rotatably connected to a mount 534. The rollers 516 center the carcass 122 with the blade assembly 504, and support the breast 128 tissues from the ventral end 134 and sides biasing the tissues toward the carcass 122. The rollers 516 are manufactured from a resilient material including nylon, and taper inward from a relatively wide base 520 to a relatively narrow tip 518, and when positioned tip-to-tip provide a general U-shaped concave contact surface (FIG. 22) for supporting the carcass 122. The spaced relationship of the rollers 516 allow the blades 506, discussed further below, to pass between the tips 518 of the rollers 516.

The mount **534** includes a pair of spaced apart arms **536** having a general T-shaped configuration that are pivotally connected to the housing **110** by a bracket **554**. The arms **536** are manufactured from a resilient material including stainless steel. Each arm **536** has a lateral member **538** extending from a first end **540** to a second end **542**, and a vertical member **544** depending therefrom. An aperture at the first end **540** receives a fastener **550** for mounting the roller **516**. A pair of braces **558** extends from the housing **110** for pivotally connecting the mount **534** thereto. Each arm **536** is connected to a brace **558** by a fastener **564** received within an aperture in the arm **536** and an aperture in the brace **558**. A brace **549** mounted to, and extending between the vertical members **544** adds structural support to the mount **534** and allows the rollers **516** to move together. A biasing member **560**, including a spring, is connected at one end to an attachment **548** on the second end **542** of the lateral member **538**, and at a second end to an attachment **562** on the housing. The biasing members **560** bias the breast **128** tissue and tenderloin **130** tissue toward the carcass **122**, and supports the carcass **122** as the blade assembly **504** partially separates the breast **128** tissue and tenderloin **130** tissue from the breast bone **144**. Alternatively, the biasing member **560** may include a band, actuator, or other structure that provides biasing characteristics. In another alternative embodiment, the arms **536** are not connected by a brace **549**, thereby allowing each arm **536** to be biased independently, thereby allowing the rollers **516** to move independently permitting greater control over the orientation of the carcass **122** as it is cut by the blade assembly **504**.

The blade assembly **504** generally includes adjacent blades **506** that are spaced apart sufficiently to pass the breast bone **144** between them and to cut the tissue along each side of the breast bone **144**. In an embodiment the blades **506** are circular and are mounted to a shaft **508** rotated by a power source **512**. The blades **506** are manufactured from a resilient material including stainless steel. A spacer **510** extends between the blades **506** providing surface for removed tissues and debris to be discharged from between the blades **506**. The spacer **510** may be manufactured from a resilient material including nylon. In an alternative embodiment of the blade assembly **504** may be independently moved toward or away from the carcass **122** allowing control over the depth the blades **506** cut the tissues.

As the carcass **122** is advanced into engagement with the guide assembly **514**, the U-shaped guide (FIG. **22**) created by the rollers **516** centers and supports the carcass **122** as the blades **506** partially separate the breast **128** tissue and tenderloin **130** tissue from the beast bone **144** along the ventral end **134**. After passing through the separator assembly **502**, the breast **128** tissue remains connected to the carcass **122** generally near the neck opening **124** between the shoulder **146** and the forward area of the breast bone **144**, and generally near the vent **126** in an area between the ribs **140** and the rear area of the breast bone **144**. The tenderloin **130** tissue generally remains connected to the carcass **122** along its surface that is medial and superficial to the breast bone **144**. After mechanical manipulation of the tissues by the processing apparatuses above, the resulting pre-cut carcass **122** is still a single carcass but with the wanted tissues mechanically manipulated and prepared for expedited manual manipulation or harvesting. As such, the carcass **122** is disengaged from the carcass mount **104** and transferred to a fixture **602** for harvesting of the wanted tissues.

The various articulated and biased structures of the back meat removal assembly **202**, cut assembly **302**, scraper assembly **402**, and separator assembly **502** may be controlled independently and automatically during use to adjust to carcasses **122** of differing dimensions and orientations thereby maximizing the tissue yield from the carcass, and minimizing incorporation of unwanted tissues or bones. The independent and automatic control may be facilitated by a microcontroller receiving input signals from sensors that detect the dimensions and orientation of the carcass **122**, and sending output signals to actuators connected to the articulated and biased structures to position the processing apparatuses.

Referring to FIGS. **26-29**, the carcass **122** is shown on a fixture **602** for manual harvesting. Referring to FIG. **25**, the fixture **602** includes an elongated body **614** attached to a support **616**. The body **614** is manufactured from a resilient material including nylon, and the support **616** is manufactured from metal including stainless steel. In an embodiment, the fixture **602** may include a securing structure (not shown) including a hook or the physical structure of the fixture **602**, for engaging the internal body cavity of the carcass **122** to retain the carcass **122** on the fixture **602** during manual harvesting. The body **614** extends between a first end **606** and a second end **608**. The first end **606** comprises a steep cone **610** with a cross sectional area generally less than the neck opening **124** of the carcass **122**. The second end **608** generally comprises a cylinder **604** with a cross sectional area generally less than the internal cavity of the carcass **122** but greater than the neck opening **124**. Between the cone **610** and the cylinder **604** is a transition **612** that tapers from a narrow cross sectional area at the cone **610** to a wide cross sectional area at the cylinder **604**. The transition **612** prevents the carcass **122** from sliding toward the second end **608** when the breast **128** and tenderloin **130** are harvested on the fixture **602**. The support **616** is an elongated member that extends into the second end **608** of the body **604**, provides structural support to the fixture **602**, and permits secure attachment of the fixture **602** to an object, such as a work station.

The cuts made by the cut assembly **302** and the separator assembly **502** above facilitate removal or hand harvesting of the breast **128** tissue and tenderloin **130** tissue because they have mechanically started removal of the tissues before they are manually removed by an operator. The operator completes removal of the wanted tissues from the carcass **122** by tearing the breast **128** tissue and tenderloin **130** tissues from the carcass **122**.

Referring to FIG. **26**, the body **614** of the fixture **602** is orientated generally vertical, and the carcass **122** is placed on the fixture **602** by positioning the vent **126** over the first end **606** and positioning the cone **610** within the neck opening **124**. The fixture **602** may be positioned in a variety of orientations that are comfortable for the operator. The operator orientates the carcass **122** with the ventral end **134** facing them, the heels of their hands orientated toward the vent **126** and facing the carcass **122**, and the thumbs on opposite sides of the breast bone **144** extending toward the neck opening **124**. The operator's fingers are placed near the top of the breast **128** tissue proximal to the shoulder **146**. Because the blade **304** of the cut assembly **302** has cut the breast **128** tissue longitudinally along the length of the carcass **122**, and the blades **506** of the separator assembly **502** have separated the breast **128** tissue and tenderloin **130** tissue from the ventral end **134** along the breast bone **144**, the breast **128** tissue remains connected to the carcass **122** generally by connective tissue in an area between the cuts and between the breast **128** tissue and tenderloin **130** tissue by the fascia.

An operator may manually manipulate and remove the breast **128** tissues from the carcass **122** by extending the other digits of the hand around the carcass **122** toward the dorsal end **136**, pinching a finger and thumb together, into generally a circle, grasping the breast **128** tissue with the fingers (FIG.

26), moving the hands down and away from the carcass **122** toward the vent **126** (FIG. **27**), thereby separating the breast **128** tissue from the carcass **122**. Accordingly, the breast **128** tissue is thereby torn from the carcass **122** beginning near the neck opening **124**, down along the tenderloin **130** tissue, and ending near the vent **126**. Once the breast **128** tissue is removed, the operator may then harvest the tenderloin **130** tissue in a similar manner by drawing the thumb between the breast bone **144** and tenderloin **130** tissue near the neck opening **124**, pinching a finger and thumb together, grasping the tenderloin **130** tissue (FIG. **28**), moving the hands down and away from the carcass **122** toward the vent **126** (FIG. **29**), thereby separating the tenderloin **130** tissue from the carcass **122**.

Mechanically manipulating the tissues as described above prepares the wanted tissues for manual harvesting by hand without the use of tools or knives. A knife may be used by an operator during hand harvesting to assist in detaching the wanted tissues from the carcass **122** or to remove any remaining unwanted tissues or bones from the wanted tissues. Manually harvesting the wanted tissues by hand allows any unwanted tissues or bones to be observed by the operator, and removed by the operator, thereby increasing the yield of wanted tissues from the carcass **122**.

In an alternative embodiment, manual harvesting of the wanted tissues from the skinless carcass **122** yields a breast tissue **128** butterfly fillet **728** with the back meat **132** attached to the breast tissue **128**. The breast tissue **128** butterfly fillet **728** with back meat **132** attached may be harvested from a carcass **122** that only encounters the scrapper **204** and cut assembly **302**, and that does not encounter the blade **214** or separator assembly **502**.

After the skinless carcass **122** encounters the scraper **204** and cut assembly **302**, the pre-cut carcass **122** is advanced to a manual tissue harvesting location. In an embodiment, the carcass **122** remains on the carcass mount **104**. In an embodiment, the carcass **122** is transferred to the mount **534**. If the carcass **122** remains on the carcass mount **104**, it advances along the conveyor system **108** to a location whereby the carcass mount **104** is repositioned, either mechanically or manually, to orientate the neck opening **124** upward, and the dorsal end **136** toward an operator. Each breast tissue **128** half is connected along the ventral end **134** adjacent the breast bone **144**. The back meat **132** remains connected to the breast tissue **128**, but it is separated from the ribs **140**. Because the blade **304** of the cut assembly **302** has cut the breast **128** tissue longitudinally along the length of the carcass **122**, the breast **128** tissue remains connected to the carcass **122** generally by connective tissue in an area along the breast bone **144**, and to the tenderloin **130** tissue by the fascia.

Referring to FIGS. **31-32**, an operator may manually manipulate and remove the breast **128** tissue from the carcass **122** as a butterfly fillet by placing the palm of their hands at the top of the breast **128** tissue, grasping the top of the breast **128** tissue near the neck opening **124**, and moving the hands down and away from the carcass **122** toward the vent **126**, thereby separating the breast **128** tissue from the carcass **122** as a butterfly fillet **728** (FIG. **33**). Once the breast **128** tissue butterfly fillet **728** is removed, the operator may then harvest the tenderloin **130** tissues (FIGS. **34-35**).

Referring to FIGS. **36-38**, the tenderloin **130** tissues are first separated from the breast bone **144** by scraping between the tenderloin **130** tissue and the breast bone **144** with a tool **730**. Scraping releases the tenderloin **130** from its natural position on the carcass **122**, and leaves the tenderloin **130** connected to the carcass **122** by a tendon **731** adjacent the neck opening **124**. The scraping may be performed by hand, or may be performed by machinery such as a tool **730** connected to a scraping assembly. The carcass mount **104** is then reoriented by adjusting the carcass mount **104** to position the neck opening **124** in the downward direction causing the tenderloin **130** tissue to fall from their natural positions (FIG. **39**). The tenderloin **130** tissue is then removed from the carcass by cutting the tenderloin **130** from the tendon **731** with a tool **734** including a knife, thereby maximizing the tenderloin tissue **130** harvested from the carcass **122** (FIGS. **40-41**). The resulting harvested wanted tissues include a breast **128** tissue butterfly fillet **728**, and two tenderloin **130** tissues (FIG. **42**).

It will be appreciated that the components of the automated deboning apparatus **102** can be used for various other applications, and may be retrofitted to other automated animal processing apparatuses. The automated deboning apparatus **102** is an exemplary representation of the mechanical tissue manipulation assemblies, and the mechanical and manual tissue manipulation steps may be carried out independently apart from the automated deboning apparatus **102**. Moreover, the components of the automated deboning apparatus **102** can be fabricated in various sizes and from a wide range of suitable materials, using various fabrication techniques, and may be a component of a larger animal processing assembly.

It is to be understood that while certain aspects of the disclosed subject matter have been shown and described, the disclosed subject matter is not limited thereto and encompasses various other embodiments and aspects.

The invention claimed is:

1. A method of harvesting tissue from a bird carcass, comprising:

mechanically scoring a lateral side of the carcass-between a point adjacent a neck opening and below a shoulder extending laterally along a side of the carcass below the ribs and a point adjacent a posterior end of the carcass;

mounting the carcass on a fixture; and

manually partially removing a breast tissue and tenderloin tissue from the carcass.

2. The method of claim **1**, further comprising the steps of:

grasping the breast tissue, with a hand, adjacent the neck opening; and

pushing the hand toward the posterior end of the carcass completely removing the breast tissue from the carcass.

3. The method of claim **1**, further comprising the steps of:

scraping between the breast bone and the tenderloin tissue;

positioning the neck opening downward; and

cutting the tenderloin tissue from the carcass.

4. A method of harvesting tissue from a bird carcass, comprising:

mechanically scoring a lateral side of the carcass between a point adjacent a neck opening and below a shoulder extending laterally along a side of the carcass below the ribs and a point adjacent a posterior end of the carcass;

mechanically partially separating a breast tissue and a tenderloin tissue from a breast bone;

positioning the neck opening upward;

grasping the breast tissue adjacent the neck opening;

encircling the tissue with two digits of a hand; and

moving the hand toward a vent at the posterior end of the carcass to completely separate the tissue from the carcass.

5. The method of claim **4**, further comprising the steps of:

scraping between the breast bone and the tenderloin tissue;

positioning the neck opening downward; and

cutting the tenderloin tissue from the carcass.

6. A method of harvesting tissue from a bird carcass, the bird carcass extending between a neck opening at an anterior

end and a vent at a posterior end, the bird carcass including a breast bone and a breast tissue at a ventral end, ribs at a dorsal end, a tenderloin tissue disposed beneath the breast tissue, and a shoulder at an anterior end, the method comprising the steps of:

mounting the carcass on a fixture; and

using an automated mechanical device to score the breast tissue between a point below the shoulder and the ribs extending laterally along a side of the carcass and a point adjacent the posterior end of the carcass.

7. The method of claim **6**, further comprising the step of separating the breast tissue and tenderloin tissue from the breast bone.

8. The method of claim **7**, wherein the separation of tissues comprises a partial separation that is done mechanically, and the method of harvesting tissue from a bird carcass further comprises:

positioning the neck opening upward;

grasping the breast tissue with a hand adjacent the neck opening and encircling the breast tissue with two digits of a hand; and

pushing the hand toward the posterior end of the carcass completely removing the breast tissue from the carcass.

9. The method of claim **8**, further comprising the steps of:

grasping the tenderloin tissue with a hand adjacent the neck opening and encircling the tenderloin tissue with two digits of a hand; and

pushing the hand toward the posterior end of the carcass completely removing the tenderloin tissue from the carcass.

10. The method of claim **9**, further comprising the steps of:

scraping between the breast bone and the tenderloin tissue;

positioning the neck opening downward; and

cutting the tenderloin tissue from the carcass.

11. The method of claim **6**, further comprising the steps of:

positioning the neck opening upward;

grasping the breast tissue with hands near the neck opening; and

pushing the hands toward the posterior end of the carcass removing the breast tissue from the carcass in the form of a butterfly fillet.

12. The method of claim **11**, further comprising the steps of:

scraping between the breast bone and the tenderloin tissue;

positioning the neck opening downward; and

cutting the tenderloin tissue from the carcass.

13. The method of harvesting tissue from a bird carcass, comprising:

mechanically scoring a lateral side of the carcass between a point adjacent a neck opening and below a shoulder extending laterally along a side of the carcass below the ribs and a point adjacent a posterior end of the carcass;

partially separating a breast tissue and a tenderloin tissue of the carcass from a breast bone;

mounting the carcass on a fixture;

positioning the neck opening upward;

grasping the breast tissue with a hand adjacent the neck opening;

pushing the hand toward the posterior end of the carcass completely removing the breast tissue from the carcass;

grasping the tenderloin tissue with a hand adjacent the neck opening;

pushing the hand toward the posterior end of the carcass completely removing the tenderloin tissue from the carcass;

scraping between the breast bone and the tenderloin tissue; and

positioning the neck opening downward; and cutting the tenderloin tissue from the carcass.

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